Radiological Health Data

VOLUME II, NUMBER 12

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Monthly Report

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

Radiological Health Data is published by the Public Health Service on a monthly basis. Data are provided to the Division of Radiological Health by other Federal agencies, State health departments, and foreign governments. Except where material is directly quoted or otherwise credited, summaries and abstracts are prepared by the Radiological Health Data and Reports Staff, Division of Radiological Health. The reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
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RADIOLOGICAL HEALTH DATA

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of environmental radioactivity due to fallout from nuclear weapons tests. During the period reported it consisted of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 of the stations operated by Public Health Service personnel. The Network was expanded during September 1961, following the resumption of nuclear weapons testing in the atmosphere by the USSR.

Measurements of gross beta radioactivity in air are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. Field measurements enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known source using a portable survey meter. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network in Washington, D.C., for a more refined measurement using a thin window proportional counter. The station located at Atlanta, Georgia, conducts its own laboratory analyses.

During August 1961, air samplers were in operation at the 44 stations on an average of 70 percent of the week. Following the resumption of nuclear weapons testing in September, the Network was expanded to 49 stations, operating on a 7-day week. Air is drawn through a cellulose carbon-loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small particles is retained on the filter. Some gaseous fission products are

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

The average values for August 1961 as pre-

sented in table 1 are generally below limits of detection by present instrumentation. Table 2 presents the average values for the 49 stations operated during September 1961. These values reflect the increase in the air levels attributable to atmospheric weapons testing.

As a result of the resumption of atmospheric nuclear weapons testing, the results of field measurements of gross beta radioactivity in surface air at RSN stations showing increased readings have been released by the Public Health Service and published almost daily by newspapers. Table 3 presents confirmed daily laboratory results for the period October 1-31, 1961 for stations selected to provide geographical coverage.

TABLE 1.—RADIOACTIVITY OF PARTICULATES IN AIR, AUGUST 1961 GROSS BETA DETERMINATIONS

Station location		Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Average[1] ($\mu\mu c/m^3$)	Station location		Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Average[1] ($\mu\mu c/m^3$)
City	State					City	State				
Anchorage	Alaska	23	<0.10	<0.10	<0.10	Minneapolis	Minnesota	8	0.21	<0.10	<0.10
Fairbanks	Alaska	23	0.12	<0.10	<0.10	Pascagoula	Mississippi	18	0.12	<0.10	<0.10
Juneau	Alaska	21	<0.10	<0.10	<0.10	Jefferson City	Missouri	24	0.11	<0.10	<0.10
Phoenix	Arizona	7	<0.10	<0.10	<0.10	Helena	Montana	23	0.11	<0.10	<0.10
Little Rock	Arkansas	22	<0.10	<0.10	<0.10	Trenton	New Jersey	15	0.13	<0.10	<0.10
Berkeley	California	23	<0.10	<0.10	<0.10	Santa Fe	New Mexico	18	<0.10	<0.10	<0.10
Los Angeles	California	22	<0.10	<0.10	<0.10	Albany	New York	29	0.24	<0.10	<0.12
Denver	Colorado	3	<0.10	<0.10	<0.10	Gastonia	North Carolina	23	0.17	<0.10	<0.11
Hartford	Connecticut	29	0.16	<0.10	<0.10	Oklahoma City	Oklahoma	22	0.20	<0.10	<0.11
Washington	District of Columbia	20	0.12	<0.10	<0.11	Ponca City	Oklahoma	24	<0.10	<0.10	<0.10
Jacksonville	Florida	22	<0.10	<0.10	<0.10	Portland	Oregon	23	0.17	<0.10	<0.10
Atlanta	Georgia	11	<0.10	<0.10	<0.10	Harrisburg	Pennsylvania	21	0.15	<0.10	<0.10
Honolulu	Hawaii	23	<0.10	<0.10	<0.10	Providence	Rhode Island	21	0.17	<0.10	<0.10
Boise	Idaho	6	0.12	<0.10	<0.11	Columbia	South Carolina	7	0.13	<0.10	<0.10
Springfield	Illinois	8	0.31	<0.10	<0.14	Pierre	South Dakota	9	0.19	<0.10	<0.10
Indianapolis	Indiana	28	0.24	<0.10	<0.11	Austin	Texas	21	0.12	<0.10	<0.10
Iowa City	Iowa	23	0.25	<0.10	<0.12	El Paso	Texas	19	0.13	<0.10	<0.10
Topeka	Kansas	24	<0.10	<0.10	<0.10	Salt Lake City	Utah	30	0.18	<0.10	<0.10
New Orleans	Louisiana	2	<0.10	<0.10	<0.10	Richmond	Virginia	23	<0.10	<0.10	<0.10
Baltimore	Maryland	23	0.13	<0.10	<0.10	Seattle	Washington	22	<0.10	<0.10	<0.10
Lawrence	Massachusetts	17	<0.10	<0.10	<0.10	Madison	Wisconsin	26	0.14	<0.10	<0.11
Lansing	Michigan	0	—	—	—	Cheyenne	Wyoming	8	<0.10	<0.10	<0.10

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—RADIOACTIVITY OF PARTICULATES IN AIR, SEPTEMBER 1961 GROSS BETA DETERMINATIONS

Station location		Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Average[1] ($\mu\mu c/m^3$)	Station location		Number samples	Maximum ($\mu\mu c/m^3$)	Minimum ($\mu\mu c/m^3$)	Average[1] ($\mu\mu c/m^3$)
City	State					City	State				
Anchorage	Alaska	27	6.6	<0.1	2.0	Pascagoula	Mississippi	24	561.9	<0.1	42.6
Fairbanks	Alaska	26	4.4	<0.1	1.1	Jefferson City	Missouri	27	584.4	<0.1	37.5
Juneau	Alaska	28	2.9	<0.1	0.7	Helena	Montana	27	12.2	<0.1	2.5
Phoenix	Arizona	25	9.2	<0.1	1.4	Trenton	New Jersey	27	69.8	<0.1	10.2
Little Rock	Arkansas	27	708.8	<0.1	43.9	Santa Fe	New Mexico	30	29.0	<0.1	4.5
Berkeley	California	26	15.9	<0.1	2.9	Albany	New York	30	81.9	<0.1	10.6
Los Angeles	California	30	5.8	<0.1	1.8	Gastonia	North Carolina	27	106.5	<0.1	11.9
Denver	Colorado	26	35.5	<0.1	3.8	Bismarck	North Carolina	17	7.1	0.2	2.6
Hartford	Connecticut	30	74.4	<0.1	7.8	Columbus	Ohio	4	15.8	6.0	9.5
Washington	District of Columbia	30	63.7	<0.1	9.6	Oklahoma City	Oklahoma	28	250.7	<0.1	16.6
Jacksonville	Florida	30	401.2	<0.1	22.1	Ponca City	Oklahoma	30	196.1	<0.1	10.1
Miami	Florida	2	2.7	0.6	1.6	Portland	Oregon	27	10.9	<0.1	2.1
Atlanta	Georgia	27	323.6	<0.1	21.5	Harrisburg	Pennsylvania	27	43.5	<0.1	7.1
Honolulu	Hawaii	27	2.5	<0.1	1.6	Providence	Rhode Island	24	59.9	<0.1	6.7
Boise	Idaho	28	29.6	<0.1	4.8	Columbia	South Carolina	25	799.2	<0.1	29.7
Springfield	Illinois	27	296.3	<0.1	17.8	Pierre	South Dakota	25	7.2	<0.1	14.9
Indianapolis	Indiana	29	56.5	<0.1	12.0	Nashville	Tennessee	15	160.6	0.5	40.6
Iowa City	Iowa	30	372.9	<0.1	23.0	Austin	Texas	30	155.0	<0.1	12.0
Topeka	Kansas	28	302.3	<0.1	23.2	El Paso	Texas	30	6.7	<0.1	1.2
Frankfort	Kentucky	10	47.3	2.6	13.0	Salt Lake City	Utah	30	24.8	<0.1	4.7
New Orleans	Louisiana	28	503.3	<0.1	32.0	Richmond	Virginia	27	101.9	<0.1	9.3
Baltimore	Maryland	27	33.4	<0.1	9.2	Seattle	Washington	26	4.7	<0.1	1.1
Lawrence	Massachusetts	27	48.0	<0.1	4.6	Madison	Wisconsin	26	210.5	<0.1	21.8
Lansing	Michigan	23	166.8	<0.1	18.0	Cheyenne	Wyoming	26	26.1	<0.1	3.2
Minneapolis	Minnesota	25	365.0	<0.1	19.8						

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 3.—DAILY MEASUREMENTS OF FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR AT SELECTED STATIONS, OCTOBER 1–31, 1961

[Concentrations in $\mu\mu c/m^3$]

Station Location	October														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Albany, N. Y.	14 [a] (21)	16 (20)	13 (23)	3.2 (17)	7.0 (20)	7.6 (23)	7.3 (36)	9.4 (27)	7.3 (26)	9.4 (26)	7.4 (33)	3.8 (42)	3.8 (29)	5.1 (33)	0.86 (40)
Anchorage, Alaska	2.0 (23)	2.1 (15)	1.3 (19)	2.3 (22)	5.3 (11)	4.1 (16)	4.1 (20)	6.6 (10)	6.8 (17)	7.4 (20)	3.0 (20)	15 (18)	12 (17)	9.4 (15)	3.8 (14)
Austin, Tex.	1.5 (19)	2.7 (16)	5.8 (16)	12 (22)	8.5 (21)	12 (28)	12 (23)	12 (18)	4.4 (25)	3.1 (25)	2.9 (26)	4.5 (26)	4.2 (30)	4.6 (27)	[b] NS
Gastonia, N. C.	7.5 (23)	23 (17)	19 (18)	2.9 (20)	5.3 (18)	7.9 (22)	6.1 (38)	12 (23)	12 (25)	10 (19)	7.9 (24)	7.4 (41)	5.8 (32)	5.1 (28)	5.8 (27)
Jacksonville, Fla.	16 (20)	9.4 (18)	5.9 (20)	6.5 (17)	5.4 (19)	10 (26)	11 (28)	NS	9.9 (25)	11 (22)	7.5 (41)	7.4 (34)	4.6 (30)	0.70 (18)	7.5 (21)
Lansing, Mich.	[b] NS	6.7 (24)	20 (17)	18 (11)	14 (20)	11 (31)	12 (31)	2.3 (30)	10 (25)	8.3 (22)	10 (27)	14 (26)	5.2 (26)	2.9 (23)	3.7 (22)
Los Angeles, Calif.	8.8 (21)	9.6 (17)	11 (17)	11 (17)	NS	19 (25)	13 (29)	NS	NS	8.7 (28)	7.6 (29)	9.2 (34)	10 (30)	NS	NS
Minneapolis, Minn.	7.0 (16)	18 (14)	8.7 (19)	9.5 (18)	14 (19)	4.9 (24)	9.2 (46)	9.1 (27)	5.7 (23)	0.74 (13)	6.5 (20)	2.2 (32)	3.4 (23)	4.1 (22)	5.7 (25)
New Orleans, La.	3.7 (17)	1.9 (13)	1.6 (31)	9.9 (19)	9.8 (20)	10 (21)	8.5 (51)	3.5 (22)	5.7 (26)	8.2 (24)	7.5 (31)	7.1 (30)	5.9 (36)	3.6 (34)	9.2 (18)
Salt Lake City, Utah	26 (19)	16 (15)	11 (16)	15 (19)	12 (22)	8.2 (21)	7.9 (37)	6.5 (26)	1.9 (23)	4.2 (19)	5.1 (28)	5.3 (33)	3.2 (18)	1.8 (20)	1.6 (15)
Seattle, Wash.	NS	3.6 (15)	8.2 (19)	8.7 (18)	3.7 (19)	NS	2.8 (27)	3.8 (19)	1.9 (29)	NS	2.0 (19)	NS	1.9 (14)	0.2	0.7 (15)
Springfield, Ill.	1.5 (20)	19 (21)	13 (17)	13 (18)	13 (25)	11 (21)	16 (12)	11 (31)	NS	7.2 (28)	6.1 (29)	9.0 (26)	8.5 (30)	3.9 (21)	4.7 (25)
Topeka, Kans.	1.7 (11)	3.2 (17)	9.7 (22)	18 (20)	12 (20)	11 (23)	12 (33)	9.0 (29)	5.0 (24)	4.6 (25)	6.7 (26)	4.5 (32)	2.6 (28)	4.5 (23)	5.0 (21)
Washington, D. C.	18 (19)	23 (21)	18 (17)	5.7 (20)	5.9 (25)	7.6 (21)	8.0 (50)	9.0 (30)	9.5 (29)	12 (22)	6.3 (35)	NS	6.8 (36)	5.8 (28)	6.3 (20)

Station Location	October															
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Albany, N. Y.	14 (18)	9.8 (13)	9.6 (17)	7.8 (17)	6.2 (20)	4.3 (19)	6.7 (25)	9.4 (37)	12 (32)	8.7 (38)	6.6 (30)	8.7 (13)	6.5 (19)	8.7 (19)	11 (26)	4.7 (27)
Anchorage, Alaska	2.4 (22)	1.4 (26)	4.6 (20)	4.9 (21)	5.6 (21)	0.64	0.54 (41)	0.93 (20)	1.5 (38)	1.0 (47)	2.0 (43)	1.7 (44)	3.9 (33)	1.9 (16)	3.4 (31)	2.3 (30)
Austin, Tex.	14 (23)	20 (20)	22 (18)	8.6 (22)	9.2 (21)	5.3 (28)	5.6 (38)	8.4 (21)	7.9 (26)	7.8 (35)	6.6 (34)	13 (17)	5.2 (28)	3.8 (31)	3.1 (24)	1.3 (29)
Gastonia, N. C.	9.4 (29)	8.6 (18)	14 (15)	12 (16)	8.5 (22)	2.2 (32)	4.9 (23)	9.4 (41)	7.7 (23)	5.8 (37)	6.7 (25)	31 (10)	25 (20)	19 (20)	18 (20)	9.5 (20)
Jacksonville, Fla.	12 (23)	21 (17)	17 (16)	22 (15)	NS	13 (23)	NS	1.8	6.6 (23)	7.6 (39)	7.0 (33)	18 (24)	49 (17)	43 (23)	15 (20)	23 (17)
Lansing, Mich.	11 (20)	15 (13)	18 (14)	24 (15)	4.8 (21)	3.4 (40)	2.8 (30)	10 (37)	7.5 (30)	7.1 (26)	9.8 (16)	5.9 (18)	16 (22)	19 (31)	12 (29)	6.2 (17)
Los Angeles, Calif.	2.9 (28)	1.9 (24)	1.5 (30)	2.6 (22)	2.4 (27)	2.0 (33)	7.3 (23)	12 (15)	18 (18)	18 (24)	NS	14 (23)	9.5 (25)	18 (18)	7.2 (22)	8.6 (26)
Minneapolis, Minn.	2.9 (20)	3.8 (20)	7.1 (18)	4.0 (18)	2.8 (21)	3.1 (18)	4.5 (24)	4.9 (17)	7.8 (16)	11 (22)	2.2 (29)	3.3 (23)	6.0 (32)	5.9 (26)	5.9 (15)	6.0 (19)
New Orleans, La.	14 (24)	14 (18)	6.9 (23)	3.6 (35)	6.8 (24)	6.4 (24)	2.5 (32)	2.6 (32)	2.1 (28)	1.6 (43)	4.6 (26)	14 (24)	26 (22)	12 (25)	3.9 (27)	8.4 (26)
Salt Lake City, Utah	1.3 (30)	1.9 (27)	6.4 (13)	38 (12)	15 (14)	5.3 (17)	2.3 (12)	5.2 (26)	9.7 (23)	15 (18)	10 (25)	16 (14)	8.4 (17)	2.4 (13)	3.4 (23)	4.9 (27)
Seattle, Wash.	1.5 (25)	4.2 (20)	3.1 (30)	4.2 (25)	2.7 (23)	2.2 (23)	2.3 (20)	1.0 (23)	2.7 (30)	NS	4.6 (15)	2.4 (25)	3.3 (19)	1.4 (37)	2.2 (15)	2.2 (25)
Springfield, Ill.	6.1 (21)	8.4 (19)	13 (17)	11 (20)	3.8 (20)	1.8 (35)	1.9 (25)	2.4 (43)	2.7 (22)	3.1 (31)	15 (14)	4.3 (24)	12 (17)	19 (21)	13 (28)	1.9 (21)
Topeka, Kans.	5.2 (20)	23 (11)	22 (18)	4.6 (20)	4.6 (23)	8.6 (23)	8.2 (43)	9.1 (24)	9.1 (28)	9.4 (22)	6.0 (41)	10 (16)	7.6 (26)	6.2 (21)	1.7 (33)	1.3 (17)
Washington, D. C.	4.4 (20)	8.2 (16)	15 (17)	11 (18)	9.6 (21)	7.9 (11)	5.2 (23)	8.2 (37)	5.1 (25)	3.9 (31)	8.8 (18)	3.5 (21)	2.6 (15)	10 (23)	10 (26)	4.9 (26)

[a] Figures in parentheses denote age of fission products in days.
[b] NS—No sample received (i.e., motor, power or filter failure).

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Robert A. Taft Sanitary Engineering Center, Public Health Service

Natural background radioactivity in our atmosphere is an important public health consideration because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon-222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter holder.

The data are computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period August 14-September 8, 1961, appears in table 1.

REFERENCE

Setter, L. R. and Coats, G. I., "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, Vol. *22*, No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS, AUGUST 14–SEPTEMBER 8, 1961

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
August 14	0810	72.0	86.3	630	190	7.6	0.08
15	0820	24.1	29.4	810	190	8.3	0.07
16	0810	23.8	28.6	1000	180	8.8	0.13
17	0809	23.9	28.3	860	170	8.1	0.11
18	0809	24.0	27.7	890	220	6.9	0.18
21	0810	72.0	82.2	470	230	4.9	0.05
22	0815	24.0	28.3	540	190	6.5	0.09
23	0815	24.0	28.3	590	280	5.7	0.06
24	0815	24.0	27.8	400	130	3.6	0.02
25	0815	24.0	27.8	310	90	2.4	0.05
28	0808	71.8	82.8	1090	170	9.0	0.06
29	0806	23.9	27.7	710	220	5.6	0.08
30	0820	24.2	28.6	710	180	4.7	0.06
31	0810	23.8	28.4	1000	200	8.5	0.10
September 1	0800	23.8	27.7	200	90	2.8	0.07
5	0810	96.1	110.2	950	90	10.1	0.01
6	0800	23.8	27.9	730	180	5.7	<0.01
7	0806	24.1	29.7	240	130	1.2	0.12
8	0815	24.1	29.9	420	180	2.7	0.05
Average				660	170	6.0	0.07
Range of counting errors (2σ)							
Maximum				60	30	1.1	0.05
Minimum				25	15	0.4	0.01

Radioactivity Measurements In Air

U.S. Naval Research Laboratory

Radioactivity measurements of air-filter samples collected at various sites near the 80th Meridian (West) are made by the U.S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during July 1961 is presented in table 1, and the radioactivity profile for the same month and the first and second quarters of 1961 are shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air. The concentrations in table 1 are expressed in disintegrations per minute per cubic meter of air at the collecting site (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

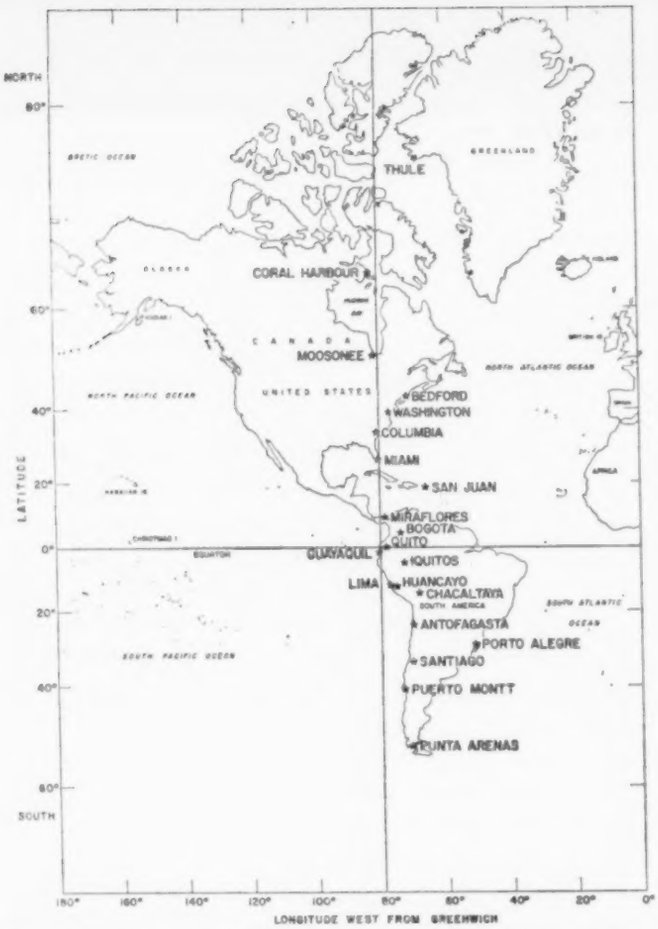
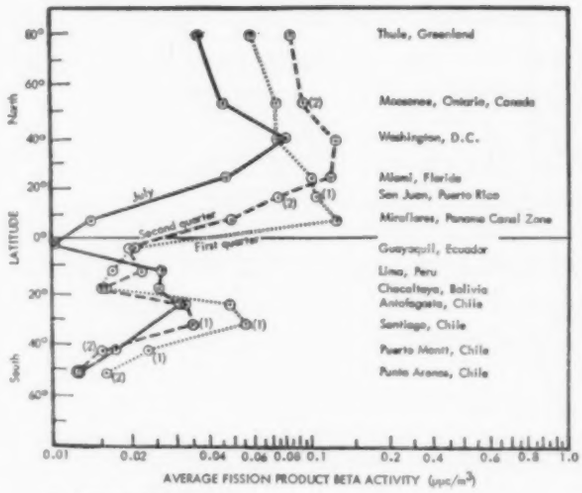


FIGURE 1. — ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (W)



(1) Average based on one month.
(2) Average based on two months.

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), FIRST QUARTER, SECOND QUARTER AND JULY 1961

TABLE 1.—DAILY RECORD OF FISSION PRODUCT GROSS BETA ACTIVITY COLLECTED BY AIR FILTRATION, JULY 1961

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	0.03	----	0.04	0.03	----	----	0.04	0.08	0.19	0.18	0.02
2	0.03	----	0.04	0.03	----	----	0.04	0.08	0.19	0.18	0.02
3	0.03	----	0.04	0.03	----	----	0.04	0.08	0.19	0.18	0.02
4	0.03	----	0.06	0.06	----	0.01	0.02	0.15	0.22	0.09	0.02
5	0.03	----	0.06	0.06	----	0.01	0.02	0.15	0.22	0.09	0.08
6	0.02	0.04	0.06	0.06	----	0.01	0.02	0.15	0.22	0.09	0.08
7	0.02	0.04	0.06	0.06	----	0.01	0.02	0.15	0.22	0.09	0.08
8	0.05	0.05	0.06	0.06	0.15	0.01	0.02	0.15	0.22	0.90	0.08
9	0.05	0.05	0.06	0.06	0.15	0.01	0.02	0.15	0.22	0.09	0.08
10	0.05	0.05	0.06	0.06	0.15	0.01	0.02	0.15	0.22	0.09	0.08
11	0.06	0.03	0.07	0.09	0.02	0.01	0.03	0.08	0.19	0.10	0.08
12	0.06	0.03	0.07	0.09	0.02	0.01	0.03	0.08	0.19	0.10	0.08
13	0.02	0.01	0.07	0.09	0.02	0.01	0.03	0.08	0.19	0.10	0.06
14	0.02	0.01	0.07	0.09	0.02	0.01	0.03	0.08	0.19	0.10	0.06
15	0.03	0.02	0.07	0.09	0.02	0.01	0.03	0.12	0.19	0.10	0.06
16	0.03	0.02	0.07	0.09	0.02	0.01	0.03	0.12	0.19	0.10	0.06
17	0.03	0.02	0.07	0.09	0.02	0.01	0.03	0.12	0.19	0.10	0.06
18	0.02	0.03	0.09	0.04	0.05	0.01	0.04	0.11	0.15	0.12	0.06
19	0.02	0.03	0.09	0.04	0.05	0.01	0.04	0.11	0.15	0.12	0.12
20	0.02	0.05	0.09	0.04	0.05	0.01	0.04	0.07	0.15	0.12	0.12
21	0.02	0.05	0.09	0.04	0.05	0.01	0.04	0.07	0.15	0.12	0.12
22	0.02	0.02	0.09	0.04	0.05	0.01	0.04	0.07	0.15	0.12	0.12
23	0.02	0.02	0.09	0.04	0.05	0.01	0.04	0.07	0.15	0.12	0.12
24	0.02	0.02	0.09	0.04	0.05	0.01	0.04	0.07	0.15	0.12	0.12
25	0.02	0.03	0.07	0.05	0.07	0.02	0.03	0.09	0.14	0.06	0.12
26	0.02	0.03	0.07	0.05	0.07	0.02	0.03	0.09	0.14	0.06	0.10
27	0.02	0.06	0.07	0.05	0.07	0.02	0.03	0.09	0.14	0.06	0.10
28	0.02	0.06	0.07	0.05	0.07	0.02	0.03	0.09	0.14	0.06	0.10
29	0.02	0.09	0.07	0.05	0.07	0.02	0.03	0.10	0.14	0.06	0.10
30	0.02	0.09	0.07	0.05	0.07	0.02	0.03	0.10	0.14	0.06	0.10
31	0.02	0.09	0.07	0.05	0.07	0.02	0.03	0.10	0.14	0.06	0.10
Mean (dpm/m³)	0.028	0.040	0.060	0.057	0.060	0.012	0.031	0.103	0.176	0.101	0.081
Mean (μμc/m³)	0.013	0.018	0.031	0.026	0.027	0.005	0.014	0.046	0.079	0.045	0.036

Canadian Radioactive Fallout Study Program

Department of National Health and Welfare, Dominion of Canada

As part of its radioactive fallout study program, the Radiation Protection Division, Department of National Health and Welfare, Dominion of Canada, conducts air and precipitation sampling programs.

The nationwide air sampling program is conducted for two main purposes: (1) To provide a convenient method for the early detection of changes in the fission product concentration in the air and therefore of likely changes in the deposition products on the ground, and (2) To obtain data to show the day-to-day and station-to-station variations. This may be useful to meteorologists for obtaining better understanding of the mechanisms involved in radioactive fallout distribution in the atmosphere.

A more detailed discussion of the sampling procedures, methods of analysis, and interpretation of results of the Department's radioactive fallout program is contained in the "Annual Report for 1959", Report Number CNHW (RP-3).

With the permission of the Department of National Health and Welfare, Dominion of Canada, *Radiological Health Data* published data on fission product gross beta activity in air and precipitation in Volume II, Numbers 1, 4, and 8, covering the periods July 1959-June

TABLE 1.—FISSION PRODUCT GROSS BETA RADIOACTIVITY IN AIR, FIRST QUARTER 1961

[Average concentration in $\mu\mu c/m^3$]

Station location	January	February	March
Calgary	0.14	0.10	0.12
Chatham	0.10	0.14	0.12
Coral Harbour	0.11	0.14	0.18
Edmonton	0.12	0.15	0.13
Fort Churchill	0.10	0.13	0.15
Fort William	0.12	0.14	0.16
Fredericton	0.09	0.09	0.13
Goose Bay	0.09	0.13	0.14
Inuvik	0.10	0.12	0.18
Kapuskasing	0.11	0.14	0.17
Montreal	0.10	0.12	0.14
Moosonee	0.10	0.12	0.17
Ottawa	0.11	0.13	0.11
Regina	0.11	0.13	0.13
Resolute	0.06	0.10	0.09
Saskatoon	0.11	0.16	0.14
Shearwater	0.08	0.13	0.10
Torbay	0.07	0.10	0.09
Toronto	0.11	0.12	0.14
Vancouver	0.05	0.03	0.06
Whitehorse	0.13	0.13	0.14
Windsor	0.12	0.13	0.14
Winnipeg	0.15	0.15	0.15
Yellowknife	0.11	0.14	0.16

TABLE 2.—MONTHLY AVERAGE FISSION PRODUCT GROSS BETA CONCENTRATIONS IN AIR, FIRST QUARTER 1961

[Radioactivity in $\mu\mu c/m^3$]

Month	Number of stations operating 50% of the time	Minimum average of all stations	Maximum average of all stations	Overall average
January	24	0.05	0.15	0.10
February	24	0.03	0.16	0.12
March	23	0.06	0.18	0.14

TABLE 3.—FISSION PRODUCT GROSS BETA RADIOACTIVITY IN PRECIPITATION, FIRST QUARTER 1961

Station location	January		February		March	
	$\mu\mu c$/liter	Inches	$\mu\mu c$/liter	Inches	$\mu\mu c$/liter	Inches
Calgary	62.3	0.22	25.1	1.21	381.5	0.16
Chatham	9.1	4.10	15.7	3.38	16.7	4.53
Coral Harbour	153.5	0.21	27.2	0.76	98.8	0.20
Edmonton	22.8	0.34	25.8	0.74	77.5	0.18
Fredericton	18.2	3.29	19.8	3.03	6.1	3.00
Fort Churchill	10.6	0.83	9.9	0.60	10.6	1.63
Fort William	15.2	0.51	trace	1.06	47.1	1.41
Goose Bay	4.6	3.18	3.1	0.61	9.1	1.47
Inivuk	62.3	0.17	48.2	0.49	28.9	0.68
Kapuskasing	30.4	0.76	7.0	2.87	30.4	2.47
Montreal	354.2	[a] 0.03	40.3	1.45	15.2	2.71
Moosonee	6.1	1.00	8.4	1.46	4.6	3.40
Ottawa	24.3	0.57	14.9	2.65	18.2	2.44
Regina	179.4	0.40	14.9	0.57	145.9	0.27
Resolute		[b] NS		NS		NS
Saskatoon	27.4	0.50	84.5	0.38	139.8	0.39
Shearwater	27.4	3.65		NS	13.7	4.24
Torbay	15.2	3.59	16.7	4.03	12.2	8.12
Toronto	45.6	1.11	10.6	3.34	41.6	1.53
Vancouver	4.6	8.30		NS	47.1	4.57
Whitehorse	45.6	0.46	88.0	0.59	18.2	0.67
Windsor	48.6	0.79	23.7	2.90	31.9	2.67
Winnipeg	83.6	0.11	17.5	1.64	141.4	0.53
Yellowknife	12.2	1.55	13.4	0.88	10.6	0.91
Average	54.9		25.7		58.6	

[a] January 16-23 only.
[b] NS—No sample.

1960 and the third and fourth quarters 1960 respectively. Similar data are presented for the first quarter 1961 in tables 1, 2, and 3. Table 4 presents the daily results of gross beta radioactivity in air for the period September 4 to October 15, 1961. The results reflect an increase in the air levels due to the resumption of nuclear weapons testing in the atmosphere.

The overall monthly average levels shown in table 2 are higher than in the previous quarter and apparently increase from month to month in the quarter. This is the usual pattern and is probably associated with meteorological phenomena. The values in table 1, 2, and 4 are in $\mu\mu c/m^3$ whereas previously reported data has been in dpm/m^3.

The results in table 3 show that the overall monthly averages of total beta radioactivity in precipitation are about the same as the previous quarter.

TABLE 4.—DAILY RECORD OF FISSION PRODUCT GROSS BETA RADIOACTIVITY IN AIR, SEPTEMBER 4 TO OCTOBER 15, 1961

[Concentrations in $\mu\mu c/m^3$]

Station location	September																				
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Aklavik	0.05	0.05	0.05	0.14	2.8	0.21	2.5	0.9	0.45	6.8	3.8	0.14	0.45	1.9	7.2	1.6	92.2	45.9	37.4	15.8	21.2
Calgary	0.05	0.37	0.37	0.02	0.38	1.8	2.3	3.5	1.4	0.9	2.4	11.7	32.8	3.4	7.0	9.4	2.7	0.9	5.2	2.0	4.2
Chatham	0.04	0.03	0.03	0.05	0.06	[a]—	1.4	0.5	0.40	0.6	0.04	0.3	74.2	72.0	40.5	49.5	78.8	105.8	105.8	39.2	39.2
Coral Harbour	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Edmonton	0.04	—	0.09	3.4	0.07	3.5	0.12	1.1	0.22	0.09	0.5	7.0	0.7	4.5	4.0	3.1	8.1	2.9	153.0	7.4	2.8
Fort Churchill	0.06	0.06	0.06	0.06	0.07	0.5	0.01	0.04	0.04	0.7	0.8	0.32	8.1	6.3	1.8	3.3	2.5	0.7	7.4	25.6	24.3
Fort William	0.04	0.05	0.05	0.05	0.11	0.12	0.05	0.32	1.0	1.1	0.14	7.4	184.5	55.4	5.4	54.0	270.0	450.0	72.0	3.6	33.8
Fredericton	0.01	0.04	0.04	0.04	—	0.09	0.14	0.36	0.36	0.6	0.09	5.2	87.8	46.8	30.2	82.4	135.0	—	27.0	4.7	20.2
Goose Bay	0.04	0.04	0.04	0.04	0.07	0.06	0.04	2.1	5.6	0.04	0.45	1.4	45.9	19.8	43.6	11.2	11.7	8.6	67.5	54.9	16.6
Kapuskasing	0.09	0.01	0.01	0.09	0.12	0.01	0.12	0.6	0.18	0.09	1.8	—	69.8	155.2	166.5	155.2	155.2	180.0	177.8	44.6	33.8
Montreal	0.09	0.04	0.04	0.04	0.07	0.11	0.13	0.27	0.36	2.6	0.6	0.6	1.1	52.2	45.9	39.2	36.0	157.5	171.0	162.0	42.3
Moosonee	0.05	0.09	0.09	0.09	0.10	—	—	0.36	2.4	1.2	1.4	4.0	85.5	85.5	85.5	99.0	99.0	252.0	148.5	1.3	72.0
Ottawa	0.08	0.07	0.07	0.07	0.14	0.15	0.17	0.18	1.8	0.6	0.22	2.1	56.2	38.2	63.0	34.2	45.0	265.5	227.2	121.5	20.7
Regina	0.03	0.03	0.03	0.05	0.11	0.9	1.3	1.4	8.6	7.6	5.2	5.2	4.3	17.1	18.0	3.3	12.2	9.0	21.6	63.0	49.5
Resolute	—	—	—	—	—	—	—	0.04	0.04	0.45	4.5	—	—	—	—	—	—	—	—	—	—
Saskatoon	0.01	0.01	0.07	0.08	1.1	0.7	—	5.9	18.0	3.2	3.2	4.0	16.4	4.7	3.9	11.7	4.0	32.4	146.2	52.2	0.8
Shearwater	0.06	0.06	0.06	<0.01	0.09	0.08	0.5	0.32	0.14	1.4	0.18	4.1	238.5	56.2	69.3	71.1	37.8	45.0	44.6	16.2	2.0
Torbay	0.04	0.07	0.07	0.07	0.10	0.10	0.12	0.14	0.14	—	0.22	2.0	122.4	—	6.8	25.2	69.8	37.8	18.0	36.0	29.2
Toronto	0.08	0.06	0.06	0.06	0.06	0.13	0.19	0.27	0.36	0.5	0.6	2.2	6.1	319.5	102.6	51.8	40.0	112.5	14.0	126.0	7.9
Vancouver	0.02	0.02	0.02	0.09	0.10	0.09	1.6	3.8	3.1	3.3	3.9	2.2	32.8	3.6	1.2	1.0	1.4	1.8	2.2	1.7	4.7
Whitehorse	0.11	0.03	0.03	0.06	1.1	1.1	3.4	1.9	3.6	3.5	1.3	9.4	0.27	0.6	2.5	1.5	2.4	2.8	2.2	4.5	25.2
Windsor	0.04	0.06	0.06	0.06	0.18	0.20	0.23	0.14	0.40	0.5	0.18	2.6	9.4	117.0	121.5	81.0	32.8	60.8	256.5	27.4	2.8
Winnipeg	0.04	0.04	0.04	0.92	1.2	0.13	0.32	0.09	0.40	0.32	0.9	49.0	26.1	9.9	8.1	2.2	0.04	4.7	28.4	99.0	23.4
Yellowknife	0.04	0.09	0.09	0.06	0.15	0.10	0.15	0.14	1.1	0.5	2.5	9.1	2.9	8.1	2.8	7.1	1.7	81.0	162.0	38.7	21.2
Average	0.05	0.06	0.07	0.25	0.39	0.95	0.73	1.0	2.2	1.7	1.5	6.2	50.3	51.3	38.1	36.3	51.8	88.6	86.3	43.1	22.7

Station location	September						October														
	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aklavik	0.1	1.0	1.4	1.6	2.4	2.8	6.3	8.6	4.5	3.1	6.3	5.0	6.5	5.0	44.1	4.3	3.2	1.9	2.0	4.5	5.6
Calgary	23.4	9.4	9.4	8.1	7.5	28.8	30.2	25.2	18.7	15.4	34.2	7.6	5.0	10.8	7.3	20.2	2.5	11.7	—	2.3	3.2
Chatham, N. B.	9.0	5.0	4.1	4.5	11.7	4.8	5.4	41.0	83.2	15.3	2.7	63.9	29.7	18.9	10.6	10.0	7.2	17.6	17.6	5.6	17.1
Coral Harbour	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Edmonton	35.6	9.5	9.1	12.6	10.8	9.9	20.0	19.8	20.7	10.8	29.7	14.8	7.4	7.2	18.0	10.4	12.2	10.4	12.6	4.1	4.5
Fort Churchill	—	—	3.2	0.3	1.6	1.0	2.1	8.1	5.6	8.6	0.4	5.7	7.7	8.0	3.3	3.5	17.6	2.1	4.2	36.9	—
Fort William	18.1	12.2	24.3	7.6	21.2	9.0	18.0	40.5	15.5	97.6	21.8	9.9	19.9	18.9	3.2	0.1	13.1	14.1	1.2	3.0	12.8
Fredericton	9.2	3.7	3.0	13.1	33.8	4.7	14.8	77.4	23.8	0.4	16.6	23.4	10.6	11.7	7.3	11.2	12.2	12.6	13.5	16.2	4.5
Goose Bay	5.0	1.4	0.2	4.2	0.9	5.9	5.0	13.5	36.0	4.0	0.9	0.2	3.6	0.8	4.9	3.9	6.3	14.4	0.04	12.4	0.5
Kapuskasing	31.5	16.6	16.6	—	—	—	—	54.0	39.2	24.8	29.7	17.1	31.5	19.8	4.5	4.5	3.4	14.2	0.3	7.2	7.6
Montreal	11.6	8.1	2.9	29.7	7.8	6.1	36.0	41.0	36.9	12.4	25.2	14.0	29.7	25.6	25.4	26.8	8.1	10.8	25.2	15.3	3.5
Moosonee	90.9	11.3	—	—	—	—	18.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ottawa	7.9	4.3	27.9	12.2	11.0	36.9	40.5	8.3	22.5	11.2	18.2	53.1	20.0	24.3	25.2	15.8	9.8	17.1	18.0	39.6	23.9
Regina	12.4	26.6	8.5	15.8	15.8	32.4	37.8	21.2	44.1	28.8	14.0	45.0	30.6	4.1	12.6	9.0	9.2	3.6	8.6	21.6	2.4
Resolute	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Saskatoon	23.9	7.6	16.2	13.5	10.1	26.8	15.3	36.0	35.1	15.3	21.6	15.3	4.1	10.8	9.2	6.3	2.7	4.6	9.4	8.6	2.5
Shearwater	0.8	5.4	5.8	12.6	14.8	4.7	5.8	65.2	13.5	0.8	14.8	18.4	15.8	13.5	6.8	12.2	14.0	22.0	17.6	13.5	7.4
Torbay	2.5	2.1	7.6	5.4	1.6	9.0	4.5	4.6	18.0	13.0	1.4	18.0	44.1	17.6	4.4	10.8	5.4	—	—	—	—
Toronto	5.0	2.2	14.0	19.1	37.4	189.0	29.7	3.4	45.0	20.7	23.4	42.3	24.3	36.9	27.0	22.7	26.8	17.6	10.1	7.6	9.9
Vancouver	8.1	16.2	11.9	10.4	1.7	5.4	13.1	10.4	17.6	—	17.6	22.5	27.0	14.8	12.1	25.0	11.7	13.5	3.8	1.7	2.0
Whitehorse	8.6	3.9	4.0	14.8	14.0	4.0	8.3	10.4	17.6	4.0	5.0	7.2	7.6	5.3	—	10.4	6.8	4.2	29.7	10.8	14.4
Windsor	1.2	7.4	—	15.8	31.5	32.4	9.2	9.0	18.9	15.8	33.3	40.5	19.8	36.0	47.2	36.0	23.4	27.9	9.0	9.0	18.0
Winnipeg	14.0	17.6	10.1	23.4	8.8	45.0	166.5	82.8	18.0	23.4	18.4	14.8	4.7	5.4	6.8	5.6	2.3	2.0	128.2	5.6	9.4
Yellowknife	28.4	13.5	14.4	15.3	14.4	10.8	21.6	13.8	20.8	1.7	3.3	9.4	9.4	7.8	3.6	5.8	2.9	4.2	33.3	16.2	16.2
Average	16.5	8.8	9.7	12.0	12.9	23.5	24.2	28.3	26.5	16.3	16.1	21.3	17.1	14.4	14.2	12.1	9.5	11.3	18.1	12.1	8.7

[a] (—) indicates no sample.

SECTION II. — FOOD OTHER THAN MILK

Survey of Radioactivity in Food

Food and Drug Administration

The Food and Drug Administration conducts a continuing surveillance to determine the concentrations of certain radionuclides in a variety of different food items, domestic and foreign. The following tabulations present the results of surveillance of foods for strontium-90 and cesium-137. These samples were collected by representatives of Food and Drug Administration Districts.

In table 1 are assembled analyses of vegetables, fruits, nuts, dairy products, grains, and baby foods for cesium-137 with corresponding strontium-90 analyses where available. Although there are numerous exceptions, it appears generally that the cesium-137 level is comparatively higher than the strontium-90 level. However, correlation between these nuclides is very poor and it may be concluded that these results offer little encouragement to the use of the more readily determinable cesium-137 levels as meaningful indicators of strontium-90 levels in foods.

Table 2 gives the results of a survey of 1958 and 1959 tea samples imported from the countries indicated. Each sample represents, on the average, a pooling of about 5 to 10 individually-ashed tea samples. It is to be noted that the Indian, Japanese, and Formosan teas carry the highest levels of strontium-90 and by comparison, the African and South American teas, much lower levels. Of interest is the finding that soluble teas contain very much lower concentrations of strontium-90. This is in general agreement with some laboratory studies which have shown that the beverage prepared from contaminated tea leaves carries over only about 20 percent of the strontium-90.

Table 3 lists 8 categories of foods for which a number of strontium-90 analyses have been completed. Because of the relatively small number of samples originating from the same geographical areas, it is not possible at this time to draw any significant conclusions on this point. Differences between categories, however, are at once apparent as exemplified in the relatively high strontium-90 levels in wheat, and dairy products. With the exception of the dried fruits, the fresh fruits in general contain less strontium-90 than the vegetables do. This difference can also be observed in the baby foods. Of considerable interest are the differences between raw (fresh) and processed foods. Reference should be made to those items identified in the footnotes as originating from the same lot. It is notable that processing causes a considerable removal of strontium-90 from the raw product. Of particular interest is flour originating from contaminated wheat. Here the reduction in strontium-90 content is even greater. But, as has been observed elsewhere, the bran carries an even higher strontium content than the wheat kernel.

Similar FDA data on radioactivity in food were presented in *Radiological Health Data*, Volume II, Numbers 1, 8, and 9.

TABLE 1.—RADIOANALYSES OF RAW AND PROCESSED FOODS

[Concentrations in μμc/kg original material]

Category	Product	Origin		Date harvested or processed	Cesium-137	Strontium-90
		County or city	State or country			
Vegetables	Snap beans	Rhodedale	Md.	Sept. 7, 1960	7.5	14
	Green beans (canned)	Mercer	Ohio	Sept. 26, 1960	ND [2]	
	Green beans				422	
	Cabbage	Shawnee	Kans.	1960	33	7.1
	Cabbage	Monterey	Calif.	Aug. 29, 1960	7	1.1
	Cabbage	Rogers	Minn.	1960	ND	4.4
	Celery	Van Buren	Mich.	July 14, 1960–Sept. 28, 1960	ND	
	Celery	Imlay City	Mich.	Sept. 26, 1960	ND	
	Celery	Middlesex	Mass.	Sept. 8, 1960	81	
	Carrots (raw)	Wayne	N. J.	Sept. 26, 1960	371	
	Carrots (canned)	Wayne	N. J.	Sept. 26, 1960	6	1.1
	Corn (shelled)	Cranford	Ill.	Oct. 18, 1960[1]	2.2	0.31
	Lettuce	Montgomery	Md.	Spring 1960	<5	2.6
	Lettuce	Montgomery	Md.	Spring 1960	<5	8.0
	Onions	El Dorado	Calif.	Sept. 15, 1960	ND	
	Onions	Newaygo	Mich.	Aug. 25, 1960–Sept. 20, 1960	ND	
	Onions	Brooks	Oreg.	Sept. 15, 1960	ND	
	Potatoes	Johnson	Kans.	July 4, 1960	0.7	
	Potatoes	Stockton	Calif.	Aug. 17, 1960	ND	0.4
	Sweet potatoes	Ashville	N. C.[1]	Jan. 10, 1960[1]	49	
	Spinach (canned)	Muskegon	Mich.	June 20, 1960	ND	
Fruits	Apples	Okanogan	Wash.	Oct. 1960	ND	
	Apples	Lockport	N. Y.[1]	Oct. 30, 1960	4.0	
	Applesauce (strained)	Kent, Mason & Ocean	Mich.	Oct. 15, 1959	9.1	
	Apricots (dried)	San Jose	Calif.[1]	July 14, 1960	<10	4.9
	Bananas (strained)		Mex.	Jan. 24, 1961	ND	
	Peaches	San Jose	Calif.	Aug. 12, 1960	ND	0.43
	Peaches (strained)	San Jose	Calif.[1]	1960	ND	0.17
	Peaches	Carroll	Md.	Sept. 20, 1960	108	
	Peach peelings	Franksburg	Md.	Aug. 23, 1960	67	6.6
	Peaches	Cross Junction	Md.	Aug. 24, 1960	ND	1.5
	Peaches	Fremont	Mich.	Aug. 25, 1960	<2	1.2
	Tomatoes	Hancock	Va.	Sept. 1, 1960	11	2.6
	Tomatoes	Salem	Va.	Aug. 31, 1960	20	1.5
	Tomatoes	Greenville	Ohio[1]	1960[1]	ND	1.2
	Tomatoes (canned)	Madison	Ark.[1]	Jan. 9, 1961[1]	13	
Nuts	Cashews		S. India	1960	ND	
	Walnuts	Lake	Calif.	Oct. 1, 1961	17	
	Pecans	Orangeburg	S. C.	Fall 1960	ND	
	Walnuts	Marion	Oreg.[1]	Fall 1960	ND	
	Pecans	Lincoln	Okla.[1]	Apr. 6, 1961[1]	ND	
Dairy products	Milk (powdered)	Gingham, Bonneville, Jefferson	Idaho	1961	1.6	24
	Milk (evaporated)	Albany	Oreg.[1]	Dec. 20, 1960[1]	ND	12
	Milk	Mt. Vernon	Mo.[1]	Dec. 26, 1960[1]	25	
	Milk (evaporated)	Weld	Colo.	Dec. 16, 1960[1]	ND	
	Milk (evaporated)	Twin Falls	Idaho	Dec. 30, 1960[1]	ND	
	Cheese	Bongards	Minn.[1]	Sept. 15, 1960[1]	ND	
	Cheese	E. Aurora	N. Y.[1]	Dec. 28, 1960[1]	ND	
	Cheese	Pocatello	Idaho[1]	Jan. 4, 1961[1]	120	
	Cheese (cheddar)	Mt. Angel	Oreg.[1]	Jan. 3, 1960[1]	ND	104
	Cheese (cheddar)	Pike	Mo.	Jan. 23, 1961[1]	ND	
	Cheese (cheddar)	Bongards	Minn.[1]	Oct. 15, 1960[1]	26	27
	Eggs (liquid)	Wright	Minn.	Feb. 27, 1961	6.8	
	Eggs (shell)	Wright	Minn.	Feb. 27, 1961	21	
Grain & grain products.	Oat flour	Cedar Rapids	Iowa	1959[1]	70	11
	Oat flour	Cedar Rapids	Iowa	1959[1]	70	2.6
	Corn flour	Milwaukee	Wis.	1960[1]	5.2	0.09
	Oat flour	Cedar Rapids	Iowa[1]	Sept. 8, 1960[1]	23	
	Flour	Penn Yan	N. Y.[1]	Dec. 27, 1960[1]	ND	
	Corn Meal	Crawford	Ill.	Oct. 18, 1960[1]	5.9	0.17
	Flour	Montezuma	Colo.	Sept. 12, 1960[1]	1.4	
	Wheat	Gardner	Kans.[1]	1960[1]	82	20
	Wheat	Montgomery	Ill.	1960	105	19
	Wheat	Roseville	Calif.	1960	16	7.5
	Wheat	Taylor	Tex.		<25	7.0
	Wheat	Summerville	Mo.[1]	Jan. 11, 1961[1]	56	50
	Wheat	Big Horn, Campbell & Sheridan	Mont. Wyo.	Dec. 8, 1960	ND	
	Rice	Woodruff & Cross.	Ark.	Jan. 12, 1961[1]	52	
	Rice	Lonoke	Ark.	Oct. 1, 1960	ND	
	Wheat[3]	Walworth & Edmunds	S. D.	Aug. 1960	60	7.6
	Bran[3]	Walworth & Edmunds	S. D.	Aug. 1960	128	23
	Flour[3]	Walworth & Edmunds	S. D.	Aug. 1960	53	4.9
Baby foods	Beets (jr. food)	St. Paul	Minn.[1]	Apr. 13, 1960[1]	125	1.4
	Green beans (strained)	Transylvania & Henderson	N. C.	July 21, 1960	40	22
	Green beans (strained)	Mecosta & Newaygo	Mich.	Aug. 24, 1960[1]	5.3	15
	Green beans (strained)	Genesee & Livingston	N. Y.	Aug. 22, 1960	8.7	8.6
	Peas (strained)	Orleans & Genesee	N. Y.	July 18, 1960	3.6	2.4
	Spinach (strained)	Orleans & Genesee.	N. Y.	June 7, 1960	16	7.5
	Squash (strained)	Newaygo & Muskegon	Mich.	Sept. 7, 1960	2.6	4.4
	Veal (jr. food)	St. Paul	Minn.	July 19, 1960	65	0.8
	Pork (strained)	St. Paul	Minn.[1]	May 24, 1960	35	0.13
	Lamb & Broth (strained)	St. Paul	Minn.[1]	June 10, 1960	22	0.46

TABLE 1.—RADIOANALYSES OF RAW AND PROCESSED FOODS—Continued

[Concentrations in μμc/kg original material]

Category	Product	Origin		Date harvested or processed	Cesium-137	Strontium-90
		County or city	State or country			
Seafood	Sardines	San Francisco	Calif.	July 14, 1960	ND	1.2
	Tuna Fish		Japan	1960	38	0.3

[1] City processing location; all other locations are counties where produce originated.
[2] ND—Not detectable.
[3] Processed from same wheat crop.

TABLE 2.—RADIOANALYSIS FOR STRONTIUM-90 IN TEAS HARVESTED IN 1958 AND 1959

[Concentration in μμc/kg original material]

Form	Country	Number of samples	Strontium-90	
			Average	Range
Leaf	India	9	632	235–1,094
	Japan	13	591	227–1,662
	Formosa	5	353	236– 448
	Indonesia	7	125	63– 419
	Ceylon	8	186	66– 354
	Pakistan	2	719	707– 731
	Tanganyika	1	48	
	Kenya	2	188	146– 230
	Belgian Congo	3	70	54– 94
	Mauritius	1	175	
	Brazil	2	184	174– 193
Soluble	Manufacturer A		14	
	Manufacturer A		32	
	Manufacturer B		30	

TABLE 3.—STRONTIUM-90 CONTENT OF VARIOUS FOODS HARVESTED IN 1960

[Concentrations in μμc/kg original material]

Category	Product[1]	Area		Harvest month	Strontium-90
		County	State or country		
Wheat & Derivatives	Wheat (a)	Texas	Mo.	July	50
	Flour (a)	Texas	Mo.	July	7.6
	Wheat (b)	Greenbrier	W. Va.	October	58
	Bran (b)	Greenbrier	W. Va.	October	74
	Flour (b)	Greenbrier	W. Va.	October	5.5
	Wheat (c)	Cache	Utah	August	3.4
	Bran (c)	Cache	Utah	August	53
	Wheat (d)	Camas	Idaho	September	5.7
	Bran (d)	Camas	Idaho	September	7.7
	Wheat bran (e)	Walworth	S. D.	August	23
	Flour (e)	Walworth	S. D.	August	4.9
	Wheat	Monroe	Mich.	July	19
	Wheat	Johnson	Kans.	June	19
	Wheat	Johnson	Kans.	July	2[3]
	Wheat	Wayne	N. Y.	1960[2]	18
	Wheat	Walla Walla	Wash.	July	3.6
	Bran	Randolph	Mo.	July	54
	Bran	Kimball	Nebr.	July	49
Vegetables	Celery	Orange	N. Y.	September	3.3
	Celery	Wayne	N. Y.	September	9.3
	Celery	Monterey	Calif.	September	0.76
	Celery	Ventura	Calif.	September	1.5
	Celery	King	Wash.	November	2.0
	Celery	Hamilton	Ohio	October	4.2
	Onions	Madison	N. Y.	September	0.65
	Onions	Genesee	N. Y.	September	0.27
	Onions	Racine	Wis.	September	2.7
	Green beans, fresh (f)	Cattaraugus	N. Y.	September	5.0
	Green beans, canned (f)	Cattaraugus	N. Y.	September	0.42
	Green beans, fresh	Erie	N. Y.	September	3.4
	Green beans, fresh	Dorchester	Md.	September	14
	Green beans, canned	Oconto	Wis.	August	10
	Green beans, canned	Manitowoc	Wis.	August	6.0
	Snap beans, fresh	Hidalgo	Tex.	November	3.5
	Carrots, canned	Wayne	N. Y.	September	1.1
	Carrots, raw	Spokane	Wash.	November	3.3
	Carrots, raw (g)	Yakima	Wash.	November	2.0
	Carrots, canned (g)	Yakima	Wash.	November	1.0
	Carrots, frozen	Walla Walla	Wash.	November	1.7
	Carrots, raw	Clackamas	Oreg.	November	2.4
	Carrots, raw (h)	McHenry	Ill.	November	7.1
	Carrots, canned (h)	McHenry	Ill.	November	3.2
	Carrots, canned	Marquette	Wis.	October	6.3
	Carrots, raw	Washington	Wis.	October	4.1
	Carrots, raw	Manitowoc	Wis.	November	4.3
	Spinach, fresh	Yates	N. Y.	October	6.3
	Spinach, frozen	Yates	N. Y.	October	4.0
	Spinach, fresh	San Diego	Calif.	March	9.2

TABLE 3.—STRONTIUM-90 CONTENT OF VARIOUS FOODS HARVESTED IN 1960—Continued

[Concentrations in μμc/kg original material]

Category	Product[1]	Area		Harvest month	Strontium-90
		County	State or country		
	Spinach, frozen	San Diego	Calif.	March	3.5
	Cabbage	Johnson	Kans.	1960[2]	7.1
	Cabbage	Hennepin	Minn.	July	4.4
	Cabbage	Monterey	Calif.	August	1.1
Fruits[3]	Peaches, fresh (i)	Niagara	N. Y.	September	0.45
	Peaches, canned (i)	Niagara	N. Y.	September	0.74
	Peaches, canned (i)	Monroe	N. Y.	September	3.6
	Peaches, fresh	Frederick	Va.	August	1.5
	Peaches, fresh	Van Buren	Mich.	September	1.2
	Peaches, fresh	Mason	Mich.	September	1.4
	Peaches, canned	Berrien	Mich.	September	3.1
	Peaches, canned	Oceana	Mich.	September	8.9
	Peaches, fresh	Valencia	N. Mex.	September	0.45
	Peaches, fresh	Box Elder	Utah	September	0.52
	Peach peels	Carroll	Md.	August	6.6
	Tomatoes, canned	Erie	N. Y.	September	0.82
	Tomatoes, canned	Wayne	N. Y.	September	0.21
	Tomatoes, canned	Weber	Utah	September	0.53
	Tomatoes, fresh (j)	Box Elder	Utah	September	0.57
	Tomatoes, canned (j)	Box Elder	Utah	September	0.58
	Tomatoes, fresh (k)	Weld	Colo.	September	1.9
	Tomatoes, canned (k)	Weld	Colo.	September	0.80
	Tomatoes, fresh	Adair	Okla.	August	1.9
	Tomatoes, canned (l)	Adair	Okla.	August	1.2
	Tomatoes, fresh (l)	Adair	Okla.	August	5.3
	Tomatoes, fresh	Darke	Ohio	September	1.2
	Apples, whole, fresh	Wayne	N. Y.	October	1.0
	Apples, whole, fresh	Dutchess	N. Y.	September	0.89
	Apples, whole, fresh	Columbia	N. Y.	September	1.1
	Apples, whole, fresh	Ulster	N. Y.	September	1.3
	Apples, whole, fresh	Valencia	N. Mex.	October	1.4
	Apples, pulp (m)	Luzerne	Pa.	October	0.44
	Apples, peel (m)	Luzerne	Pa.	October	0.63
	Apples, core (m)	Luzerne	Pa.	October	1.0
	Apples, peel (n)	Niagara	N. Y.	October	1.3
	Apples, core (n)	Niagara	N. Y.	October	1.6
	Apples, peel (o)	Doniphan	Kans.	September	1.8
	Apples, core (o)	Doniphan	Kans.	September	2.1
Dried fruits	Raisins	Fresno	Calif.	September	3.9
	Raisins	Madera	Calif.	September	2.0
	Raisins	Tulare	Calif.	May	2.5
	Figs		Greece	1960[2]	7.7
	Figs		Greece	September	6.8
	Figs		Greece	1960[2]	9.3
	Figs		Turkey	October	2.1
	Fig paste		Turkey	November	7.8
	Fig paste		Turkey	November	7.7
	Fig paste		Portugal	October	9.4
	Dates		Portugal	1960[2]	8.7
	Dates		Iraq	1960[2]	0.59
	Dates		Iraq	1960[2]	1.5
Seafoods	Sardines		Calif.	October	0.54
	Sardines		Calif.	Calif.	1.2
	Sardines		Calif.	1960	0
	Sardines		Calif.	1960	0
	Haddock		Atlantic Coast	1960	0.33
	Haddock		Atlantic Coast	October	0.10
	Haddock		Atlantic Coast	February	2.1
	Oysters		Chesapeake Bay	November	0.43
	Clams		Chesapeake Bay	November	4.6
Dairy products	Milk, evaporated	Linn	Oreg.	December	12
	Milk, evaporated		Wis.	November	12
	Cheese, cheddar		Minn.	January	51
	Cheese, cheddar		Minn.	1960	27
	Cheese, cheddar		Oreg.	1960	104
Baby food	Applesauce			1960	1.1
	Applesauce			1960	1.2
	Peaches			1960	0.13
	Peaches			1960	0.43
	Bananas			1960	0.19
	Green beans			1960	22
	Green beans			1960	15
	Green beans			1960	8.6
	Spinach			1960	7.5
	Squash			1960	4.4
	Peas			1960	2.8
	Beets			1960	4.8
	Lamb			1960	0.35
	Lamb & lamb broth			1960	0.46
	Pork			1960	0.13
	Beef & beef broth			1960	0.89
	Oat flour			1960	2.6
	Corn flour			1960	0.10

[1] Code letters in parentheses indicate same lots of crop, i.e., flour (a) derived from Texas, Mo. wheat (a).
[2] Month not available.
[3] Where designated fresh, fruit is unpeeled.

Tri-City Diet Study

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The dietary survey of strontium-90 content of average diets of individuals living in New York City, San Francisco and Chicago was continued by the Health and Safety Laboratory. The results of the fourth sampling are presented in table 1. Previous data were reported in HASL-90 (*1*), 111 (*2*), and 113 (*3*) and presented in *Radiological Health Data*, Volume II, Numbers 4, 6 and 10.

Selected foods, representing 19 food categories, are purchased at each of these three cities about every three months and are analyzed for strontium-90 and stable calcium. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium-90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document.

The data indicate that there has been no substantial change in the relative contributions of the various foods to the total intake, or in the total intake of strontium-90 since the last sampling. Contributions of this element from tap water are not included in table 1. However, recent measurements show the contributions from tap water to have 132, 176, and 132 μμc of strontium-90 per year at New York City, Chicago and San Francisco, respectively. It was assumed in making these estimates that the average daily intake of tap water is 1.2 liters.

Using the totals given in table 1, the following average concentrations in μμc Sr^{90}/gm Ca may be derived for the year: New York, 9.3; Chicago, 9.1; San Francisco, 3.9.

No seasonal effect on the strontium-90 levels in food can yet be observed. Due to the resumption of atmospheric testing of nuclear weapons, it will be difficult to determine how the levels might have varied with season had the moratorium been continued.

REFERENCES

(*1*) *Quarterly Summary Report, HASL-90,* August 18, 1960
(*2*) *Quarterly Summary Report, HASL 111,* April 1, 1961
(*3*) *Data from Quarterly Summary Report, HASL-113,* July 1, 1961

TABLE 1.—STRONTIUM-90 LEVELS OF DIET—FOURTH SAMPLING

Food type	Annual consumption (kg/yr)	New York City February 1961		Chicago April 1961		San Francisco April 1961	
		μμc/kg	μμc/yr	μμc/kg	μμc/yr	μμc/kg	μμc/yr
Whole grain products	11	6.4	70	16.6	183	12.5	138
Refined grain products	37	8.7	322	9.7	358	6.5	242
Refined grain flour	43	5.8	251	8.2	351	0.5	23
Milk, liquid	221	7.9	1,735	5.3	1,164	2.1	464
Potatoes	45	4.6	207	4.2	189	2.8	126
Macaroni	3	3.6	11	4.0	12	3.5	10
Beans, dried	3	19.4	58	20.4	61	1.3	4
Vegetables, canned	20	2.5	50	6.6	132	0.9	16
Vegetables, fresh	43	3.5	151	9.5	416	2.4	103
Vegetables, root	17	4.4	75	9.5	155	3.6	61
Fruit, canned	26	2.2	58	1.1	29	9.4	25
Fruit juices	19	2.3	43	3.5	66	2.0	38
Fruit, fresh	68	6.5	442	4.1	279	2.3	157
Rice	3	0.1	0	1.9	6	1.7	5
Eggs	16	1.3	21	1.7	26	2.0	20
Fish, fresh	8	0.7	5	0.4	28	0.1	1
Fish, shell	1	0.9	1	0.5	1	3.9	4
Meat	73	0.7	47	0.3	23	0.3	21
Poultry	17	0.3	6	0.6	11	0.6	11
Total annual intake			3,553		3,493		1,482

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

There have been two Public Health Service Milk Monitoring Programs since the first quarter of 1960. The original network was established to develop sampling and radiochemical analytical proficiencies under conditions which would remain similar over a period of time in regard to the source of milk. During the operation of this program it became apparent that a broader sampling program more directly related to the milk consumed by the population was necessary. The result was a transition from the program of sampling raw milk, collected from milksheds of limited size, to a sampling program designed to be representative of the processed milk consumed in a given municipality. The establishment of the processed milk area sampling stations did not preclude the need for further raw milk sampling from the selected milkshed serving the same city. It was important that both networks be in operation for a sufficient period of time to provide an overlap for the purpose of a comparative study.

The processed milk area sampling stations provide adequate information as to the radionuclide content of milk. There has now been a sufficient period of overlap in the two sampling programs. Therefore, the reporting of the results of the raw milk sampling stations in *Radiological Health Data* was terminated with the publication of the June 1961 results in Volume II, Number 11.

Publication of the data from the program will normally follow about four months after sample collection because of the time required for shipment, processing, decay-product build-up, compilation of the data, and clearance and publication procedures.

Processed Milk Area Sampling Stations

During 1960, a processed milk surveillance program of about 60 stations was established to provide information on levels of radioactivity in fluid milk consumed by the public. These stations were established in cooperation with State and local health and milk sanitation agencies. Each city was selected to provide adequate coverage with respect to production areas and the consuming population. The emphases of this expanded sampling and radioassay program are:

1. to measure the levels of radioactivity of the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the processing plant, and
2. to provide one sampling point within each State with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups.

FIGURE 1.—PROCESSED MILK AREA SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY IN MILK—PROCESSED MILK AREA SAMPLING STATIONS, SECOND QUARTER AND JULY 1961

[Radioactivity concentrations in $\mu\mu c$/liter]

Area	Calcium (gm/liter)		Strontium-90		Cesium-137		Area	Calcium (gm/liter)		Strontium-90		Cesium-137	
	Second quarter	July	Second quarter	July	Second quarter	July		Second quarter	July	Second quarter	July	Second quarter	July
Albuquerque, N.M.	1.06	1.08	5	2	5	<5	Memphis, Tenn.	1.30	1.26	13	10	10	10
Atlanta, Ga.	1.29	1.20	10	10	20	20	Milwaukee, Wis.	1.19	1.20	6	5	20	10
Austin, Tex.	1.24	1.18	3	2	5	<5	Minneapolis, Minn.	1.07	1.04	7	10	10	20
Baltimore, Md.	1.23	1.14	8	12	15	25	New Orleans, La.	1.30	1.27	13	12	20	20
Boston, Mass.	1.21	1.17	11	12	35	40	New York, N. Y.	1.17	1.14	9	10	25	15
Buffalo, N. Y.	1.22	1.13	8	8	15	15	Norfolk, Va.	1.26	1.20	9	10	20	20
Burlington, Vt.	1.22	1.19	8	10	15	20	Oklahoma City, Ok	1.22	1.16	8	6	5	<5
Charleston, S. C.	1.25	1.19	12	10	25	25	Omaha, Nebr.	1.07	1.30	6	9	10	10
Charleston, W. Va.	1.20	1.19	9	10	15	10	Palmer, Alaska	1.03	1.05	9	7	5	5
Charlotte, N. C.	1.26	1.20	12	12	15	15	Philadelphia, Pa.	1.18	1.18	9	10	15	15
Chattanooga, Tenn.	1.33	1.24	11	11	15	15	Phoenix, Ariz.	0.97	1.01	5	3	5	<5
Chicago, Ill.	1.17	1.12	8	6	10	20	Pittsburgh, Pa.	1.27	1.15	12	14	20	20
Cincinnati, Ohio	1.24	1.19	9	10	10	<5	Portland, Me.	1.26	1.16	10	11	40	40
Cleveland, Ohio	1.20	1.24	8	6	10	5	Portland, Oreg.	1.05	1.05	12	12	30	30
Dallas, Tex.	1.24	1.18	9	8	10	20	Providence, R. I.	1.17	1.19	10	12	40	45
Denver, Colo.	1.01	1.04	6	5	5	10	Sacramento, Calif.	1.05	1.05	5	5	<5	5
Des Moines, Iowa	1.01	1.10	7	7	5	10	Salt Lake City, Utah	1.01	1.18	5	3	10	10
Detroit, Mich.	1.17	1.15	8	7	15	<5	San Francisco, Cal.	1.04	1.10	5	4	10	5
Grand Rapids, Mich	1.25	1.18	7	6	15	10	San Juan, P. R.	1.23	1.16	4	4	5	<5
Hartford, Conn.	1.17	1.13	9	10	30	20	Seattle, Wash.	1.03	1.02	9	14	25	20
Helena, Mont.	1.02	1.07	6	7	10	15	Spokane, Wash.	1.02	1.05	8	8	15	15
Honolulu, Hawaii	0.96	1.00	4	5	10	10	St. Louis, Mo.	1.09	1.10	8	7	20	10
Idaho Falls, Idaho	1.04	1.06	5	9	10	10	Syracuse, N. Y.	1.19	1.18	7	7	15	10
Indianapolis, Ind.	1.23	1.18	8	6	10	20	Tampa, Fla.	1.23	1.19	6	6	110	70
Jackson, Miss.	1.35	1.26	14	10	15	20	Trenton, N. J.	1.17	1.16	9	8	15	15
Kansas City, Mo.	[a] 1.08	1.06	[a] 12	11	[a] 15	10	Washington, D. C.	1.18	1.12	8	8	20	15
Laramie, Wyo.	1.00	1.01	5	8	10	10	Wichita, Kans.	1.01	1.21	8	14	10	5
Las Vegas, Nev.	1.00	1.02	3	3	5	5	Wilmington, Del.	1.20	1.18	10	8	15	30
Little Rock, Ark.	1.21	1.22	19	17	25	15							
Louisville, Ky.	1.18	1.10	11	9	10	<5	Average	1.16	1.14	8	8	15	15
Manchester, N. H.	1.23	1.20	12	10	45	55							

[a] Average based on two Months' samples.

The processed milk sampling program was designed to sample processed fluid milk (pasteurized and homogenized) rather than the raw product. The sampling procedure was originally developed to provide a sample from one day's sales per month in a community which would be as representative of the total supply as can be achieved under practical conditions. Each sample is a composite of those plants supplying not less than 90 percent of a city's milk supply. The contribution from each plant to the total sample is approximately proportional to the volume of milk sold. Due to the resumption of weapons testing, the frequency of sampling was increased during September and October.

The samples from the processed milk stations are collected with the assistance of the various State and local health and milk sanitation agencies and are shipped for analyses to either the Southeastern or Southwestern Radiological Health Laboratory. The Southeastern Radiological Health Laboratory processes samples from the 30 states generally east of the Mississippi, and the Southwestern Radiological Health Laboratory processes samples from the western states. Figure 1 shows the locations of these stations.

Radioassays for Sr^{90}, Cs^{137}, Sr^{89}, Ba^{140}, and I^{131} are performed. The values for Sr^{89}, Ba^{140}, and I^{131} for July 1961 were below the levels of detection by present instrumentation and are therefore not shown in table 1. The lower level of detection for Sr^{89} is 5 $\mu\mu$c/liter, and for Ba^{140} and I^{131}, 10 $\mu\mu$c/liter. Other radionuclides of concern to public health agencies will be included for assay as necessary for a more complete monitoring of the milk supply.

The program of daily sampling for I^{131} analyses was continued at selected stations. Table 2 presents daily laboratory results from October 11-31, 1961, for those stations. *Radiological Health Data,* Volume II, Number 11, presented the daily I^{131} results for the period September 19 through October 10, 1961.

TABLE 2.—DAILY IODINE-131 DETERMINATIONS, PROCESSED MILK AREA SAMPLING STATIONS, OCTOBER 11–31, 1961

[Concentrations in $\mu\mu$c/liter]

Area	October																				
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Atlanta, Ga	70	70	100	—	—	70	120	50	50	60	—	—	10	40	40	70	70	—	—	20	30
Austin, Tex	30	20	40	20	20	20	20	20	30	30	20	—	20	20	60	20	30	50	50	30	50
Charleston, S. C	50	70	50	60	—	50	20	50	30	50	50	—	40	50	40	70	30	20	—	50	—
Chicago, Ill	150	150	160	—	—	120	110	120	110	120	—	—	100	120	130	110	110	—	—	150	130
Denver, Colo	100	—	—	80	—	110	100	—	90	90	80	—	—	—	—	60	—	—	—	—	50
Jackson, Miss	100	110	90	—	—	80	60	50	50	60	—	—	70	50	50	50	50	—	—	20	—
Milwaukee, Wis	140	140	120	140	180	130	130	110	140	130	90	100	50	120	130	180	180	160	210	170	150
New Orleans, La	90	80	60	—	—	80	50	70	50	60	—	—	50	40	80	60	60	—	—	50	20
New York, N. Y	110	—	100	70	—	70	80	80	130	90	100	—	100	100	120	90	90	70	—	80	90
Omaha, Nebr	240	300	—	90	—	320	260	250	—	—	—	—	120	150	150	170	—	—	—	140	90
Palmer, Alaska	—	—	—	—	—	—	—	—	—	—	—	—	270	220	—	150	—	—	120	—	90
Pascagoula, Miss	80	110	120	—	—	80	90	80	70	70	—	—	70	40	30	70	70	—	—	20	40
Sacramento, Calif	<10	<10	<10	—	—	—	20	—	—	—	—	—	—	—	—	—	—	—	—	90	90
Salt Lake City, Utah	120	130	120	—	—	100	100	120	90	100	—	—	100	100	120	100	130	—	—	110	160
Seattle, Wash	80	90	110	110	—	110	120	90	110	90	110	—	90	100	80	100	150	260	200	—	350
St. Louis, Mo	150	170	150	140	—	150	120	120	110	110	150	—	140	120	110	120	120	140	—	100	80
Tampa, Fla	—	—	—	—	—	—	—	30	20	50	—	—	40	30	50	70	50	—	—	40	—
Washington, D. C	80	70	—	70	—	50	40	50	60	50	40	—	50	60	80	80	70	80	—	60	—
Wichita, Kans	—	120	120	100	—	—	100	110	—	140	140	150	—	120	120	—	120	130	—	100	—

Raw Milk Sampling Stations

The June 1961 data presented in *Radiological Health Data,* Volume II, Number 11, are the last regular publication of the results from the raw milk sampling program. The limitations inherent in the size of the program and the procedures used for collecting milk samples have made necessary the broader program more directly related to the milk consumed by the population. The establishment of the Processed Milk Area Sampling Stations resulted from this need, and, after a period of overlap, obviated the necessity for continued publication of the raw milk data. Collection and analyses of samples of raw milk will continue in connection with research on factors influencing the levels of radionuclides in milk and the results will be made available from time to time.

The following discussion by personnel of Milk and Food Research, and Radiological Health Research Activities, Robert A. Taft Sanitary Engineering Center, Public Health

Service, summarizes the results of the Raw Milk Sampling Program.

SUMMARY RESULTS FROM RAW MILK SAMPLING PROGRAM

The Public Health Service undertook early in 1957 an investigation to determine the amounts and kinds of fission products in foods in response to increasing awareness that the nuclear weapons tests of various nations were resulting in the discharge of ever-increasing amounts of radioactive contaminants into the environment and in recognition of the damaging capabilities of "high" concentrations of at least some of these products.

Milk was chosen as the first item of the diet to be surveyed. Reasons for this choice includes: (a) evidence indicates that milk was probably a major contributor of Sr^{90} to the total diet, (b) milk is consumed extensively by almost all segments of the population, especially children, (c) milk is produced on a year-round basis in almost every area of the United States and, (d) this food item offers the possibility of developing one set of methods that would be equally applicable to all samples.

Preliminary examination of several market milk supplies using methods of analysis available at the time showed that cesium-137, iodine-131, strontium-89, strontium-90, and barium-140 were present in significant concentrations and led to the decision that all of them should be routinely determined. With this in mind, a sequential system of analysis for these fission products was developed (*3,5,6*). Attention was given particularly to the development of simple and relatively fool-proof methods which could be successfully carried out by well trained but non-professional personnel and which were suitable for use with large numbers of samples. A technique was developed by which milk could be transported from distant locations to a central laboratory for analysis by the addition of 4 ml of 40% formaldehyde per gallon of milk and using air parcel post for transportation. Samples handled in this manner almost without exception will remain in a fluid state without obvious decomposition and will be satisfactory for radionuclide analysis for over one week.

Monthly collections of raw milk samples were taken from discrete geographical areas within specified milksheds serving large urban populations in different regions of the United States. The following criteria were used in developing each of these stations:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.
2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.
3. The milk samples were from a supply that was part of a metropolitan milkshed.
4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

Analysis of samples collected in this manner provided the information necessary for research on the factors influencing the levels of radionuclides in milk as well as some notion regarding radionuclide exposure of population groups in the various metropolitan areas.

During the first year of operation five areas were selected for surveillance: New York, Cincinnati, St. Louis, Salt Lake City, and Sacramento. In the second year stations were added at Atlanta, Chicago, Fargo-Moorhead, Austin, and Spokane. Continuous monthly samples have been received from all stations since their initiation except for Fargo-Moorhead which discontinued participation in January 1960.

Methods

One-gallon raw milk samples are taken monthly from collecting stations in each area under surveillance, preserved with 4 ml of 40% formaldehyde, and forwarded to the Robert A. Taft Sanitary Engineering Center for radionuclide analysis. Each sample collected in a manner to meet the specification previously outlined is representative of lots of milk ranging from 2,000 to 90,000 gallons of the total milk supply of the designated area. The concentrations of iodine-131, barium-140, and cesium-137 are measured by gamma scintillation spectroscopy (*4*) while total radioactive strontium and strontium-90 are determined following radiochemical separation (*6,7*). The amount of strontium-90 is determined by counting, in a low-background anti-coincidence counter, the

build-up of yttrium-90 after a two-week ingrowth period. The total radioactive strontium is determined in a shielded proportional counter and the difference between this figure and that determined for strontium-90 is reported as strontium-89. Stable calcium and potassium are also determined routinely on all samples (*9,10*).

Since initiation of the project, several of the analytical procedures have been improved or simplified. Prior to use for surveillance activities each new procedure has been shown to have a precision and sensitivity equal to or better than the method replaced, thus making all of the data obtained in connection with the Raw Milk Sampling Stations comparable with one exception. The initial radiochemical procedure for cesium-137 was found to include a contribution from the beta-emitting rubidium-87 which is not seen by the gamma-spectrometer. Accordingly, the cesium-137 values from May 1957 to January 1959 may be high by as much as 15-20 μμc per liter of milk.

Results and Discussion

Results of analysis for all the samples collected in the Raw Milk Sampling Program from May 1957 through June 1961 have been published elsewhere (*1,2,11*) and accordingly are not tabulated in connection with this summary. Considerations of these results have been limited to the gross relationship between fallout and the occurrence of some of these fission products in milk as influenced by time and geographical location. For purposes of convenience the results have been divided into two groups based upon the half-lives of the radionuclides. The first group consists of strontium-90 and cesium-137, both with half-lives of about 28 years, while the second group consists of iodine-131, barium-140, strontium-89, having half-lives of approximately 8, 13, and 63 days respectively.

Table 3 summarizes the average yearly concentrations of Sr^{90} in the monthly milk samples from each of the locations of the Raw Milk Sampling Program. Based on an analysis of variance of the data obtained during 1959, the cities have been grouped to indicate significant differences between geographical locations. It is seen that there is no significant difference in the average strontium-90 concentration in the milk from Sacramento, Austin, and Salt Lake City. The levels of strontium-90 in the milk from Chicago and New York is higher than the first group of cities, but significantly lower than the concentrations observed in the samples from Cincinnati, Spokane, Atlanta, and Fargo-Moorhead. However, the average concentration of strontium-90 in milk from the portions of the milksheds serving St. Louis is significantly higher than that from any other area. This type of statistical treatment is dependent on the observed variation in the sample and does not infer biologically significant differences.

It is evident also from these data that the relative levels of strontium-90 in milk have remained constant with respect to geographical location throughout the entire study.

Levels of strontium-90 within a given milkshed, however, are not constant. Analysis of the variance, applied to these data, oftentimes revealed significant differences which appeared to be associated with the seasons of the year

TABLE 3.—AVERAGE CONCENTRATION OF STRONTIUM-90 AND CESIUM-137 IN MONTHLY RAW MILK SAMPLES

[Concentrations in μμc/liter]

Station	Strontium-90					Cesium-137				
	1957	1958	1959	1960	[b] 1961	1957	1958	1959	1960	[b] 1961
Sacramento, Calif.	[a] 4.4	5.1	5.0	3.3	3.7	[a] 46	34	23	9	8
Austin, Tex.		[a] 3.5	6.0	4.3	3.5		[a] 23	33	15	8
Salt Lake City, Utah	[a] 4.7	4.3	6.7	6.0	3.5	[a] 57	39	37	30	11
Chicago, Ill.		[a] 7.6	8.6	9.4	6.5		[a] 40	47	30	20
New York, N. Y.	[a] 5.8	6.5	9.3	9.4	8.0	[a] 43	41	39	26	18
Cincinnati, Ohio	[a] 5.9	8.5	12.8	9.9	9.0	[a] 39	48	37	23	16
Spokane, Wash.		[a] 8.8	12.2	11.2	7.5		[a] 50	67	36	17
Atlanta, Ga.		[a] 11.3	15.5	14.6	12.7		[a] 44	66	35	25
Fargo-Moorhead, N. D.		[a] 13.6	14.4				[a] 65	52		
St. Louis, Mo.	[a] 9.4	13.2	22.2	18.0	17.3	[a] 50	57	74	29	25

[a] Approximately last half of year.
[b] Through June 1961.

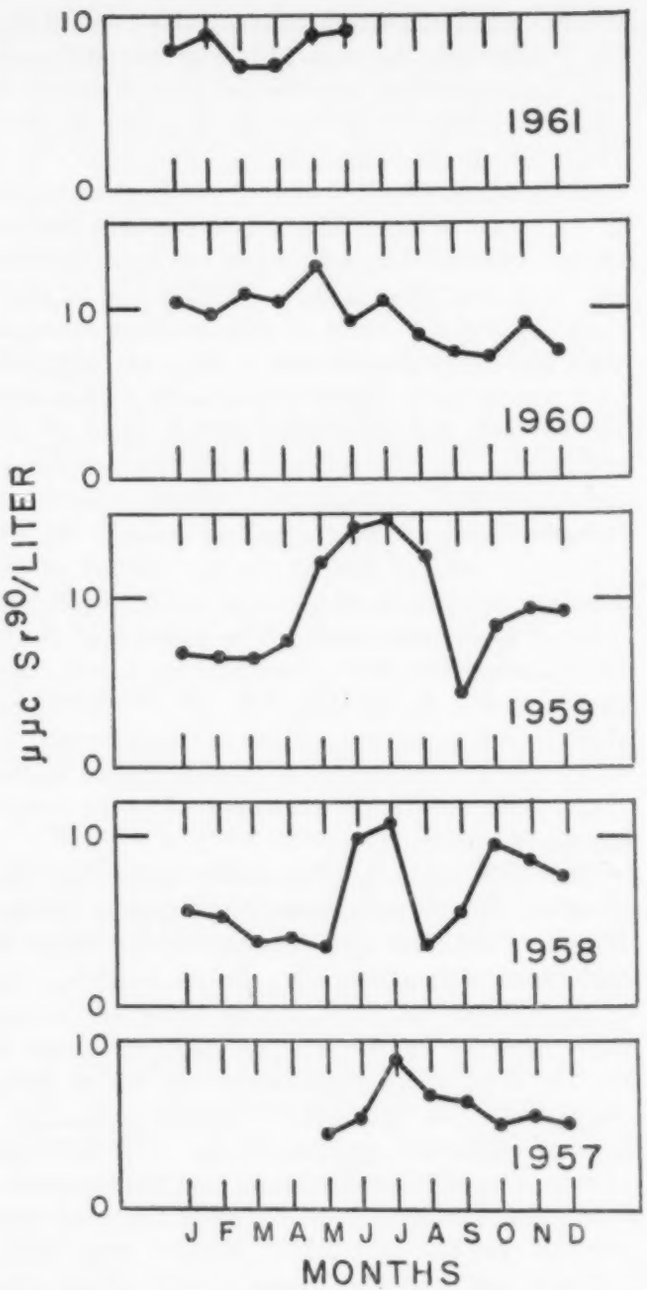

FIGURE 2.—CONCENTRATIONS OF STRONTIUM-90 IN MILK (NEW YORK)

and independent of weapons tests. An example is seen in figure 2. Here, the levels of strontium-90 observed in the milk samples obtained from the New York milkshed have been plotted as a function of time-month. It is seen that there is a pronounced increase in concentration of strontium-90 during the spring months (statistically significant during 1959 and 1960) and again during the fall. Similar variations have been observed in most of the other milksheds although in many cases these differences are not significant.

In table 3, the annual average concentrations of cesium-137 in the monthly milk samples are summarized. In a general way the variations observed with this radionuclide are similar to those observed for strontium-90.

An analysis of variance applied to the 1959 findings indicated that the milk from Sacramento contained significantly less cesium-137 than that from any other area while milk from St. Louis had a significantly higher concentration. The remaining geographical areas fell into one of two intermediate groups as indicated. Seasonal variations as seen in figure 3 were observed in all locations and the samples produced during the spring of 1959 contained significantly more cesium-137 than samples produced at other times. Although there is no clear association between the concentrations of this radionuclide and weapons test activities, the concentration of cesium-137 has decreased at a more rapid rate than strontium-90 in all geographical locations since cessation of weapons tests in October 1958. This is also seen in figure 3 in which the levels of strontium-90 and cesium-137 observed in the samples from Atlanta have been plotted with respect to time. The probable reason for this difference in behavior is related to the differential absorption of strontium-90 and cesium-137 through the root systems of plants although the half-lives of these two radionuclides are approximately the same.

In contrast to the findings with the long half-life radionuclides, correlation between weapons tests and the occurrence of the short half-life radionuclides in milk was observed for all

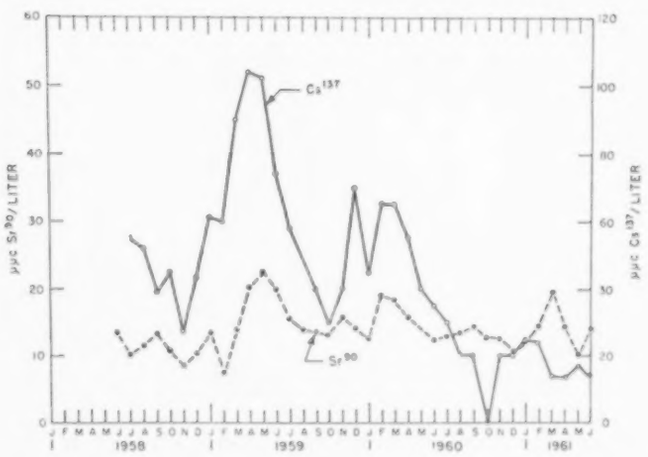

FIGURE 3.—CONCENTRATIONS OF STRONTIUM-90 AND CESIUM-137 IN MILK (ATLANTA)

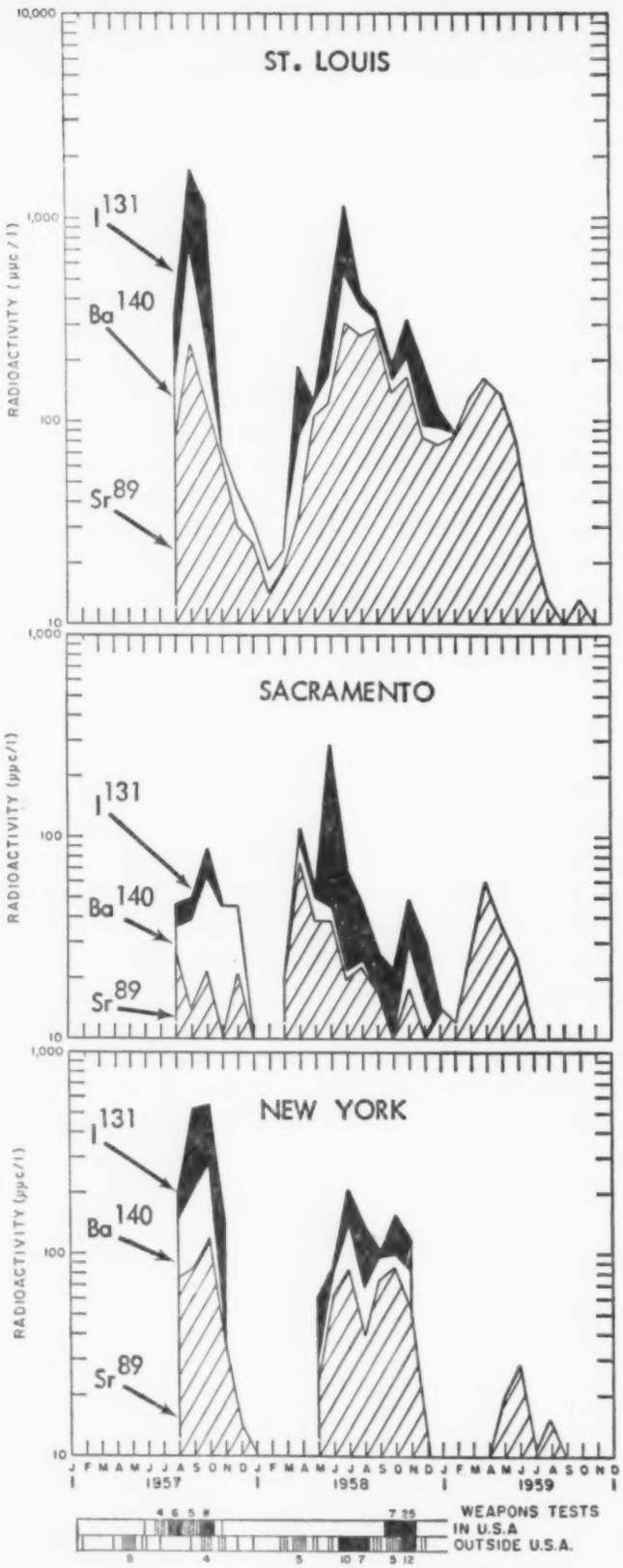

FIGURE 4.—CONCENTRATIONS OF SHORT HALF-LIFE RADIONUCLIDES IN RAW MILK

areas. In figure 4 the radioactivity contributed by iodine-131, barium-140, and strontium-89 has been summed and plotted as a function of time since May 1957 for the samples received from St. Louis, Sacramento, and New York milksheds. At the foot of the graph, the number of weapons tests conducted inside and outside the continental United States has been marked on the same time scale. Although it is clear that the highest levels of radioactivity coincide with the periods of weapons tests, the relationship cannot be established precisely as the number of tests do not reflect fission yield of the explosions and the collection of the samples in the Raw Milk Sampling Stations was made independently of the testing program. This is especially evident during the last period of the continental tests in which most of the explosions were of low fission yield. The pattern of activity observed for New York and St. Louis samples appears to be true for all of the areas studied with the exception of Sacramento in which the concentration of the short-life radionuclides is relatively non-responsive to continental weapons tests.

This difference is presumably related to the location of the milkshed with respect to the Nevada Test Site and the prevailing west to east movement of the air. In all locations, no iodine-131 or barium-140 was observed in any milk samples by the end of 1958 or about 3 months after the last weapons test which coincides well with predictions based on the half-lives of these two radionuclides. The half-life of strontium-89 is sufficiently long that measurable concentrations were expected and observed through the fall of 1959 or about a year after the last test and the seasonal variations previously mentioned were also observed here. Although no weapons tests were conducted in the period under consideration after October 1958, the levels of strontium-89 were found to increase steadily from January 1959 to reach a peak in the spring coinciding with the maximum concentration found in strontium-90 in the same period, thus indicating that additional strontium-89 was deposited during the period or otherwise made available to the cattle. After the spring peak the levels of strontium-89 were found to have decreased at a rate approximately equal to its half-life.

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Radioactivity In Milk

Health and Safety Laboratory, U.S. Atomic Energy Commission

The results of analyses of milk by the Atomic Energy Commission's Health and Safety Laboratory at four locations in the United States for December 1960 and January through April 1961 are presented in table 1. Data for previous months appear in *Radiological Health Data* Volume I, Numbers 1, 2, 3, 5, 7, and 8, and Volume II, Numbers 3 and 6.

TABLE 1.—STRONTIUM-90 AND CALCIUM IN MILK SAMPLES, DECEMBER 1960–APRIL 1961 [1]

Sampling station and month	Strontium-90			Calcium		Sampling station and month	Strontium-90			Calcium	
	μμc/liter	μμc/kg	μμc/gm Ca	gm/liter	gm/kg		μμc/liter	μμc/kg	μμc/gm Ca	gm/liter	gm/kg
Perry, New York (powdered milk)						Mandan, North Dakota (powdered buttermilk)					
December 1960		49	4.8		10.3	December 1960		90	10.6		8.5
January 1961		65	6.5		10.1	January 1961		114	10.4		11.0
February 1961		65	7.0		9.3	February 1961		122	11.6		10.5
March 1961		59	6.5		9.0	March 1961		122	10.9		11.2
April 1961		65	7.2		9.1	April 1961		140	12.2		11.5
New York City (liquid milk)						Honolulu, Hawaii [2] (liquid milk)					
December 1960	7.1		6.3	1.14		December 1960	3.4		3.2	1.07	
January 1961	7.5		6.7	1.11			2.4		3.2	1.05	
February 1961	7.8		7.3	1.08		January 1961	2.0		1.8	1.12	
March 1961	9.4		8.1	1.15			3.0		2.7	1.12	
April 1961	8.6		6.5	1.31		February 1961	2.1		2.4	0.88	
							3.6		3.5	1.03	
						March	1.9		1.9	1.01	
							3.2		3.1	1.03	
						April	1.9		2.0	0.96	
							2.8		2.8	1.00	

[1] Data from *Quarterly Summary Reports*, Hasl-113, July 1961 and HASL-115, October 1961.
[2] Two results per month represents milk from two dairies.

Strontium-90 in Canadian Dried Milk Products

Department of National Health and Welfare,
Dominion of Canada

The following table presents the results of measurements of strontium-90 in Canadian dried milk for the months of January, February, and March, 1961. This table was included in the "Quarterly Report of the Radio-Active Fallout Study Program," dated August 1961, published by the Radiation Protection Division of the Department of National Health and Welfare, Ottawa, Canada. Figure 1 shows the sampling locations. The samples were collected by inspectors of the Marketing Division, Department of Agriculture.

Data for the year of 1960 were published in *Radiological Health Data,* Volume I, Numbers 6 and 9, and Volume II, Numbers 4 and 8.

FIGURE 1.—MILK SAMPLING STATIONS IN CANADA

TABLE 1.—STRONTIUM-90 CONTENT OF CANADIAN DRIED MILK POWDER SAMPLES

[Concentrations in $\mu\mu c$/gm calcium]

Station	January 1961	February 1961	March 1961
Calgary	6.9	7.2	6.8
Charlottetown	11.5	10.5	NS [3]
Chicoutimi	10.6	10.2	13.3
E. Florenceville	NS	NS	NS
Edmonton	8.1	8.3	8.8
Granby	6.6	6.2	6.0
Halifax [1]	11.2	8.7	8.7
La Durantye	16.0	11.6	14.9
London	4.3	4.4	4.0
Megantic	12.7	12.9	12.7
Moncton [2]	12.4	10.1	10.0
Ottawa	7.5	6.2	4.1
Saskatoon [2]	8.3	7.1	5.1
Sussex	14.1	8.3	10.7
Vancouver	8.9	9.4	10.1
Walkerton	4.7	6.8	4.8
Winnipeg [2]	5.5	7.1	4.9
Average	9.3	8.4	8.3

[1] New Station. Natural strontium concentration not yet determined. A factor of 1.06 was used for correction of the sample. The results of all other stations were corrected for natural strontium in the sample. This determination was made by neutron activation at A.E.C.L. Chalk River.
[2] Buttermilk sample. All other samples are skim milk.
[3] NS—No milk powder manufactured for the month.

SECTION IV. — WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provision of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies, and industrial organizations commenced operations in October 1957. At present, there are 90 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally has approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the USSR is expected ultimately to raise the level of radioactivity in surface waters again, but no significant increase had been noted to October 1, 1961.

For the first two years of the network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses

were being conducted weekly. Weekly analyses were to be continued indefinitely from all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations on composites of 2 or 3 weekly samples were conducted for stations which still showed some beta activity above background. Monthly determinations on composities of all samples received from a station during the month were conducted on samples from streams where beta activity was at background levels.

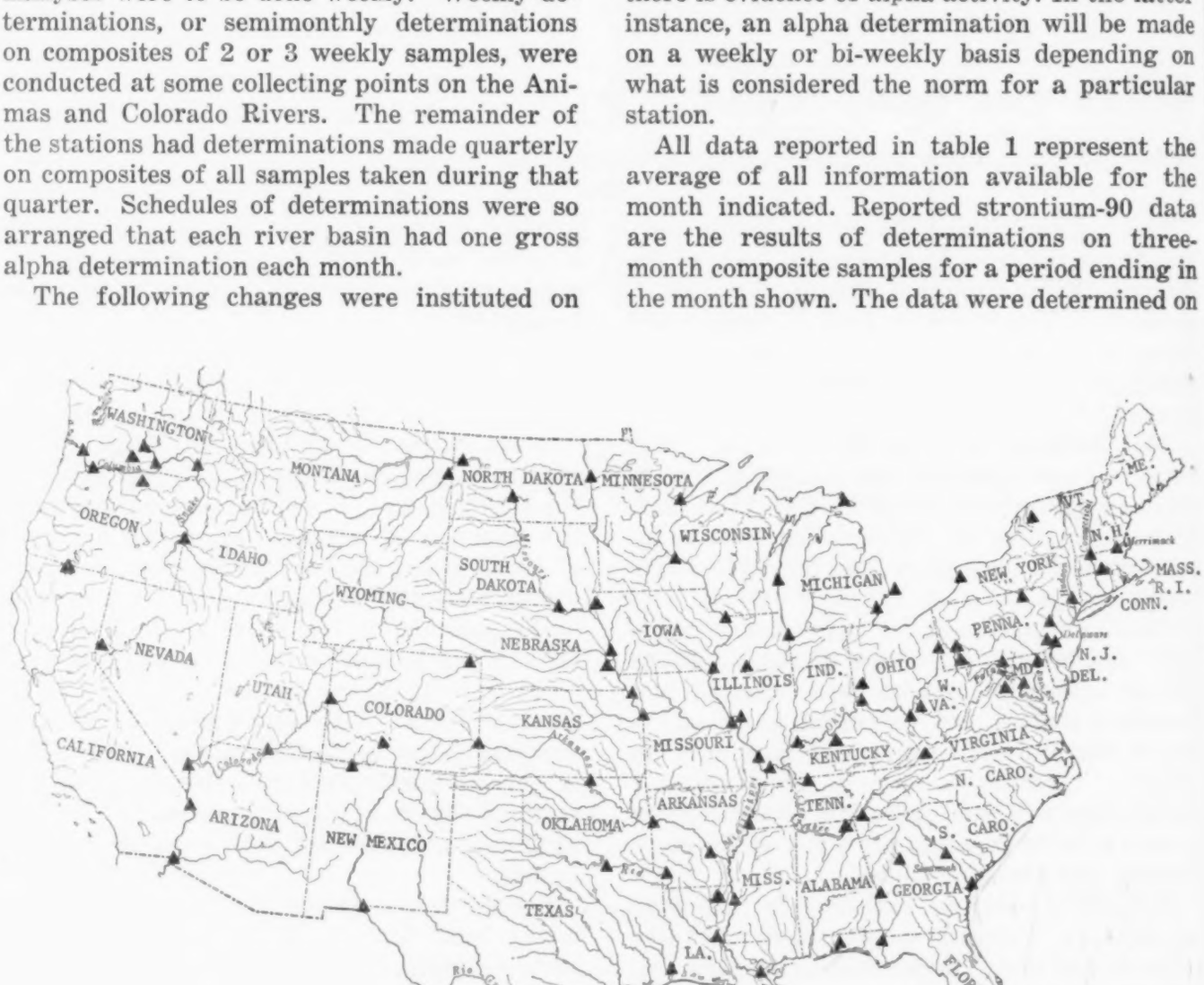
Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. Weekly determinations, or semimonthly determinations on composites of 2 or 3 weekly samples, were conducted at some collecting points on the Animas and Colorado Rivers. The remainder of the stations had determinations made quarterly on composites of all samples taken during that quarter. Schedules of determinations were so arranged that each river basin had one gross alpha determination each month.

The following changes were instituted on September 1, 1961, following resumption of nuclear weapons testing:

1. Gross beta counts are to be made on all samples collected. (Compositing weekly samples for monthly or semimonthly gross alpha and beta counting will cease.)
2. Beginning with samples collected October 1, 1961, strontium-90 determinations are to be made on a three-month composite of weekly samples.

Gross alpha counts are to be made on one sample for each station each month, unless there is evidence of alpha activity. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all information available for the month indicated. Reported strontium-90 data are the results of determinations on three-month composite samples for a period ending in the month shown. The data were determined on



As of August 14, 1961

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in $\mu\mu c$/liter]

Station	Quarter ending June 30, 1961	June 1961					
		Beta activity			Alpha activity		
	Strontium-90	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.2	0	0	0	0	<1	<1
Animas River: Cedar Hill, N. Mex	[a]—	2	6	8	<1	4	4
Arkansas River:							
Coolidge, Kansas	—	17	3	20	0	46	46
Ponca City, Okla	0.7	0	12	12	5	4	9
Big Sioux River: Sioux Falls, S. Dak	—	0	4	4	1	3	4
Chattahoochie River: Atlanta, Ga	0.3	<1	<1	1	<1	2	3
Colorado River:							
Loma, Col	—	7	3	10	3	4	7
Page, Ariz	2.3	25	<1	26	20	4	24
Boulder City, Nev	—	0	0	0	0	11	11
Parker Dam, Ariz-Calif	—	3	1	4	0	8	8
Yuma, Ariz	—	0	0	0	<1	9	10
Columbia River:							
Wenatchee, Wash	—	0	0	0	0	0	0
Pasco, Wash	—	7	41	48	0	0	0
Bonneville Dam, Oreg	—	24	19	43	0	0	0
Clatskanie, Oreg	1.1	12	15	27	0	0	0
McNary Dam, Oreg	—	12	42	54	0	0	0
Connecticut River: Northfield, Mass	—	0	0	0	0	0	0
Delaware River:							
Martins Creek, Pa	0.4	0	0	0	0	0	0
Philadelphia, Pa	—	0	0	0	0	0	0
Escambia River: Century, Fla	—	0	0	0	1	0	1
Great Lakes:							
Buffalo, N. Y	—	0	0	0	0	0	0
Detroit, Mich	—	0	0	0	0	0	0
Port Huron, Mich	—	0	0	0	0	0	0
Gary, Ind	—	0	0	0	0	0	0
Milwaukee, Wis	0.3	0	0	0	<1	<1	<1
Sault Ste. Marie, Mich	—	0	0	0	0	0	0
Duluth, Minn	—	0	0	0	0	0	0
Hudson River: Poughkeepsie, N. Y	0.5	1	2	3	0	0	0
Illinois River: Peoria, Ill	—	0	12	12	<1	<1	1
Kanawha River: Winfield Dam, W. Va	—	0	0	0	0	0	0
Klamath River: Copco, Oreg	0.3	<1	<1	1	0	0	0
Little Miami River: Cincinnati, Ohio	—	0	<1	<1	<1	<1	<1
Merrimac River: Lowell, Mass	—	0	0	0	0	0	0
Mississippi River:							
Minneapolis, Minn	—	0	0	0	0	0	0
Dubuque, Iowa	—	0	0	0	0	0	0
Burlington, Iowa	—	0	0	0	1	1	2
E. St. Louis, Ill	0.5	6	0	6	0	0	0
Cape Girardeau, Mo	—	0	0	0	8	1	9
West Memphis, Ark	—	7	1	8	3	1	4
Delta, La	—	1	2	3	9	2	11
New Orleans, La	0.6	6	2	8	4	<1	4
Missouri River:							
Williston, N. Dak	—	19	4	23	13	3	16
Bismarck, N. Dak	0.6	0	0	0	0	3	3
Yankton, S. Dak	—	0	8	8	0	4	4
Omaha, Nebr	0.7	5	12	17	3	4	7
St. Joseph, Mo	—	20	0	20	2	0	2
Kansas City, Kans	—	22	0	22	18	4	22
St. Louis, Mo	—	24	3	27	29	4	33
Monongahela River: Pittsburgh, Pa	—	0	0	0	0	0	0
Ohio River:							
East Liverpool, Ohio	—	0	0	0	1	0	1
Huntington, W. Va	—	0	0	0	0	0	0
Louisville, Ky	—	1	<1	2	2	0	2
Evansville, Ind	—	0	0	0	1	2	3
Cairo, Ill	—	0	0	0	10	3	13
Potomac River:							
Williamsport, Md	0.8	0	0	0	0	0	0
Red River North: Grand Forks, N. Dak	1.5	0	0	0	0	2	2
Red River, South:							
Index, Ark	—	0	0	0	2	0	2
Denison, Tex	—	0	0	0	0	6	6
Alexandria, La	—	0	0	0	1	5	6
Rio Grande River:							
Alamosa, Colo	—	0	6	6	0	1	1
El Paso, Tex	—	10	11	21	1	12	13
Laredo, Tex	—	14	0	14	23	3	26
Brownsville, Tex	0.3	3	0	3	1	4	5
Sabine River: Ruliff, Tex	0.8	0	0	0	1	0	1
St. Lawrence River: Massena, N. Y	—	0	0	0	<1	<1	<1
Schuylkill River: Philadelphia, Pa	—	0	0	0	0	0	0
Savannah River:							
Port Wentworth, Ga	0.5	<1	73	74	0	0	0
North Augusta, S. C	0.5	0	0	0	0	0	0
Snake River: Wawawai, Wash	—	0	3	3	0	1	1
South Platte River: Julesburg, Colo	—	0	30	30	2	22	24
Susquehanna River:							
Sayre, Pa	—	0	0	0	0	0	0
Conowingo, Md	—	0	3	3	0	1	1

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Concentrations in μμc/liter]

Station	Quarter ending June 30, 1961	June 1961					
	Strontium-90	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Tennessee River:							
Chattanooga, Tenn.	—	0	50	50	1	0	1
Bridgeport, Ala.	0.9	0	56	56	0	0	0
Yakima River: Richland, Wash.	—	<1	0	<1	<1	0	<1
Yellowstone River: Sidney, Mont.	0.8	41	2	43	2	1	3

[a] Dash denotes no sample received or no determinations made.

analytical schedules in effect till September 1, 1961.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.50.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167-169.

(3) Setter, L. R., Regnier, J. E., and Diephaus, A., "Radioactivity of Surface Waters in the United States," J. AWWA *51*, 1377 (1959).

(4) Straub, C. P., Setter, L. R., Goldin, S., and Hallbach, P. F., "Strontium-90 in Surface Waters," J. AWWA *52*, 756 (1960).

(5) Setter, L. R., and Baker, S. L., "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

Strontium-90 in Tap Water

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Atomic Energy Commission's Health and Safety Laboratory performs analyses for strontium-90 concentrations in tap water for Richmond, California, and New York City on a monthly basis. Previous data were presented in *Radiological Health Data*, Volume I, Numbers 1, 5, and 9, and Volume II, Numbers 4 and 9. Table 1 gives the data for the first quarter 1961 and the yearly averages for 1959 and 1960.

TABLE 1.—STRONTIUM-90 IN TAP WATER [1]
FIRST QUARTER 1961

Location	Month	Activity (μμc/liter)
Richmond, California (40 liters per sample)	Average 1959	0.29
	Average 1960	0.26
	January 1961	0.29
	February	0.32
	March	0.33
New York City (100-200 liters per sample)	Average 1959	0.40
	Average 1960	0.47
	January 1961	0.36
	February	0.31
	March	0.37

[1] Data from *Quarterly Summary Report, HASL-115*, dated October 1, 1961.

SECTION V. — OTHER DATA

External Gamma Activity

Radiation Surveillance Network, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise but are sufficiently accurate to illustrate any significant variations above background. The values shown in the following table do not show an increase in the external gamma levels as a result of atmospheric nuclear weapons testing.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, SEPTEMBER 1961

Station location	Average (mr/hr)	Station location	Average (mr/hr)
Anchorage, Alaska	0.01	Minneapolis, Minn	0.01
Fairbanks, Alaska	0.01	Pascagoula, Miss	0.01
Juneau, Alaska	0.01	Jefferson City, Mo	0.01
Phoenix, Ariz	0.02	Helena, Mont	0.03
Little Rock, Ark	0.01	Trenton, N. J	0.02
Berkeley, Calif	0.01	Santa Fe, N. Mex	0.03
Los Angeles, Calif	0.02	Albany, N. Y	0.03
Denver, Colo	0.02	Gastonia, N. C	0.02
Hartford, Conn	0.01	Bismarck, N. D	0.01
District of Columbia	0.02	Oklahoma City, Okla	0.01
Jacksonville, Fla	0.03	Ponca City, Okla	0.04
Miami, Fla	0.02	Portland, Oreg	0.02
Atlanta, Ga	0.02	Harrisburg, Pa	0.01
Honolulu, Hawaii	0.03	Providence, R. I	0.02
Boise, Idaho	0.02	Columbia, S. C	0.02
Springfield, Ill	0.01	Pierre, S. D	0.02
Indianapolis, Ind	0.01	Nashville, Tenn	0.01
Iowa City, Iowa	0.02	Austin, Tex	0.01
Topeka, Kans	0.02	El Paso, Tex	0.02
Frankfort, Ky	0.01	Salt Lake City, Utah	0.02
New Orleans, La	0.01	Richmond, Va	0.01
Baltimore, Md	0.02	Seattle, Wash	0.01
Lawrence, Mass	0.02	Madison, Wis	0.02
Lansing, Mich	0.02	Cheyenne, Wyo	0.02

Registration of Radiation Producing Machines in the State of New Jersey

Radiological Health Program
New Jersey Department of Health

In 1958, the New Jersey State legislature enacted the "Radiation Protection Act" (Chapter 116, Public Law 1958). Among other provisions, it required the registration of *all* radiation sources. The first registration of *radiation producing machines* was begun during November 1959 and was in effect from December 1, 1959, for an indefinite period. The following tables present the results of the registration of *radiation producing machines* as of July 23, 1961. These tables give the age, type, and the use of the machines according to professional category of the user. The registration of *radioactive materials* was required during April 1960.

TABLE 1.—TYPES OF RADIATION PRODUCING MACHINES

Category	Radiographic	Fluoroscopic	Radiographic and fluoroscopic	Therapeutic	Electron microscope	Particle accelerator	Spectroscope or fluoroscopic unit	Other	Total	Percent of total
Industry	204	4	33	0	18	13	96	306	674	9.9
Physicians	321	446	888	161	0	0	0	1	1,817	26.7
Dentists	2,975	0	0	0	0	0	0	0	2,975	43.8
Chiropractors	172	1	18	0	0	0	0	0	191	2.8
Chiropodists	174	0	3	0	0	0	0	0	177	2.6
Veterinarians	71	2	45	1	0	0	0	0	119	1.8
Institutions	405	76	217	95	0	0	0	0	793	11.7
Schools	24	3	3	0	2	7	11	1	51	0.7
Total	4,346	532	1,207	257	20	20	107	308	6,797	
Percent of total	63.9	7.8	17.8	3.8	0.3	0.3	1.6	4.5		100

TABLE 2.—USES OF RADIATION PRODUCING MACHINES

Category	Diagnostic	Therapeutic	Diagnostic & therapeutic	Industrial	Not stated	Total	Percent of total
Industry	74	0	0	600	0	674	9.9
Physicians	1,644	165	5	0	3	1,817	26.7
Dentists	2,975	0	0	0	0	2,975	43.8
Chiropractors	190	0	1	0	0	191	2.8
Chiropodists	177	0	0	0	0	177	2.6
Veterinarians	117	2	0	0	0	119	1.8
Institutions	698	95	0	0	0	793	11.7
Schools	21	0	0	30	0	51	0.7
Total	5,896	262	6	630	3	6,797	
Percent of total	86.7	3.9	0.1	9.2	0.04		100

TABLE 3.—AGE OF RADIATION PRODUCING MACHINES

Category	Prior to 1930	1930–1939	1940–1949	1950–1959	1960–1961	Not stated	Total	Percent of total
Industry	2	3	116	364	45	144	674	9.9
Physicians	17	94	614	932	75	85	1,817	26.7
Dentists	123	364	965	1,167	276	80	2,975	43.8
Chiropractors	2	4	29	124	25	7	191	2.8
Chiropodists	0	3	41	125	5	3	177	2.6
Veterinarians	0	2	33	52	3	29	119	1.8
Institutions	8	42	222	405	88	28	793	11.7
Schools	3	1	12	21	6	8	51	0.7
Total	155	513	2,032	3,190	523	384	6,797	
Percent of total	2.3	7.5	29.9	46.9	7.7	5.6		100

Survey of Radioactivity in Animal Feeds

Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium-90 and cesium-137 in animal feeds. The following table presents the results of feeds collected in 1960 by representatives of the Food and Drug Administration Districts. Previous data concerned with levels of radioactivity in animal feeds and fodders were given in *Radiological Health Data,* Volume I, Numbers 2 and 9, and Volume II, Number 9.

TABLE 1.—RADIOANALYSES OF ANIMAL FEEDS, 1960

[Concentrations in $\mu\mu c$/kg original material]

Product	County or City	State	Date harvested or processed	Cs^{137}	Sr^{90}
Alfalfa hay	Boulder	Colo.	August		98
Alfalfa hay	Boulder	Colo.	July		41
Alfalfa hay	Larimer	Colo.	July		65
Alfalfa hay	Conejos	Colo.	August		61
Alfalfa hay	Roanoke	Va.	September		231
Lespedeza hay	Washington	Va.	October		529
Lespedeza hay	Berry	Mo.	September		960
Lespedeza Hay	Wake	N. C.	September		447
Peanut hay	Hertford	N. C.	October		507
Peanut hay	Edgecombe	N. C.	October		912
Peanut hay	Irwin	Ga.	August		733
Dried beet pulp	Grant	Kans.	November		3.8
Dried beet pulp	Washakie	Wyo.	October		55
Dried beet pulp	Logan	Colo.	October		52
Cotton seed meal	Tulare	Calif.	November		12
Cotton seed meal	Terry, Garza, Lynn, Lubbock, Hockley, Crosby	Tex.	October		3.1
Grass	Montgomery	Md.	July 18	194	145
Hay	Howard	Md.	June 1	N.D. [1]	
Corn silage	Dunn	Wis.	August, September, October	2.7	
Cotton seed meal	Raleigh [2]	N. C.	July 14	81	
Cotton seed meal	Chow Chilla [2]	Calif.	Jan. 20, 1961	34	
Cotton seed meal	Shafter [2]	Calif.	November	531	
Soyabeans	Sibley & Scott	Minn.	October	N.D.	17
Sugar beet pulp	Grant	Kans.	Nov. 17	1.1	3.8

[1] N.D.—Not detectable.
[2] Processing location.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission transmits to the Public Health Service quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data,* Volume I, Numbers 8 and 9; and Volume II, Numbers 1 through 11. Summaries follow for Argonne National Laboratory, Atomics International, and Feed Materials Production Center, for the first and second quarters of 1961.

The measured concentrations of radioactive substances in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurements (NCRP). For the general population, the applicable MPC's are one-tenth of the occupational values for continuous exposure as given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, then the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic analyses necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's if reported by the laboratory.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radioactive substance	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	Cerium-144	10,000	300
2	Cesium-137	20,000	500
3	Cobalt-58	90,000	2,000
4	Cobalt-60	30,000	300
5	Iodine-131	2,000	300
6	Plutonium-239	5,000	0.06
7	Ruthenium-106-rhodium-106	10,000	200
8	Strontium-90	100	10
9	Thorium-234-protactinium-234	20,000	1,000
10	Uranium-natural	20,000	2
11	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, At^{211}, Ra^{223}, Ra^{224}, Ra^{226}, Ac^{227}, Ra^{228}, Th^{230}, Pa^{231}, Th^{232}, and Th-nat are not present[1]	3,000	----------
12	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[1]	600	----------
13	If Ra^{226}, Ra^{228} are not present[1]	100	----------
14	Mixture of unidentified nuclides	10	0.04
15	If α emitters and Ac^{227} are not present[1]	----------	1.0
16	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[1]	----------	10
17	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[1]	----------	100

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of each nuclide is equal to or less than 1/10 of its appropriate MPC and if the sum of these ratios for the group in question is equal to or less than 1/4.

Argonne National Laboratory

University of Chicago
Lemont, Illinois

Issued September 1961

Environmental levels of radioactivity at the Argonne National Laboratory (ANL) for 1959 and 1960 were reported in *Radiological Health Data,* Volume I, Number 9 and Volume II, Numbers 4 and 7 The following report presents a summary of the data for the first and second quarters of 1961.

Air Monitoring

Air filter samples were collected continuously at seven locations on the ANL site as shown in figure 1 and at four off-site locations at Aurora (west of ANL site), Hinsdale (northeast), Joliet (southwest), and Tinley Park

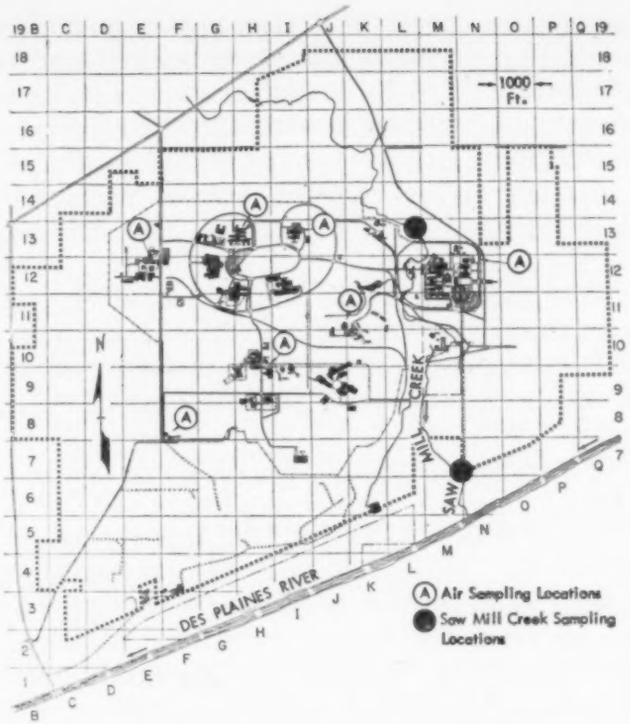


FIGURE 1.—ON-SITE SAMPLING LOCATIONS, ARGONNE NATIONAL LABORATORY

FIGURE 2.—SITE LOCATION OF ARGONNE NATIONAL LABORATORY (INCLUDING SOME OFF-SITE SAMPLING STATIONS)

(southeast). The quarterly averages of alpha, beta, and several nuclide concentrations are given in table 2.

The data shows little difference between off-site and on-site measurements for alpha activity and most of the nuclides indicating that ANL does not contribute significant quantities of these activities to the atmosphere. However, a significant difference in on-site and off-site beta activity correlates with the even more significant difference for iodine-131 for the first quarter.

During February and March considerable quantities of I^{131} were released to the atmosphere in the exhaust air from two of the ANL buildings. The highest concentration, 16.7 $\mu\mu c/m^3$ (5.6% of environmental MPC) was recorded on March 17 near one of the points of release. During February, the I^{131} concentrations in off-site filter samples were below the minimum level of detection, (0.035 $\mu\mu c/m^3$). Two of the four off-site stations did record some activity during March, the higher of the

TABLE 2.—ACTIVITIES IN AIR FILTER SAMPLES, ANL

Type of activity	Relative location	First quarter 1961		Second quarter 1961	
		Number of samples	Average concentration ($\mu\mu c/m^3$)	Number of samples	Average concentration ($\mu\mu c/m^3$)
Total alpha	On-site	73	0.0035	78	0.0041
	Off-site	42	0.0035	47	0.0041
Total beta	On-site	73	0.103	78	0.117
	Off-site	42	0.052	47	0.104
Ce^{144}	On-site	73	0.0086	78	0.013
	Off-site	42	0.0084	47	0.012
Cs^{137}	On-site	73	0.0085	78	0.012
	Off-site	42	0.0080	47	0.009
I^{131}	On-site	73	1.7	78	<0.035
	Off-site	42	0.078	47	<0.035
$Ru^{106}Rh^{106}$	On-site	73	0.065	78	0.075
	Off-site	42	0.063	47	0.068

two concentrations being 0.041 $\mu\mu c/m^3$ (0.14% of environmental MPC). During the second quarter all of the samples, both off-site and on-site, showed I^{131} concentrations to be less than 0.035 $\mu\mu c/m^3$.

Neglecting the effect from I^{131}, the second quarter beta activity was roughly twice that recorded during the first quarter. This was true at all sampling locations, and is attributed to the usual Spring increase in the fall-out rate of stratospheric debris from past nuclear detonations.

Water Monitoring

ANL waste water is discharged into Sawmill Creek, a stream that runs through the Argonne grounds and enters in the Des Plaines River about 500 yards downstream from the waste water discharge. Sampling locations on Sawmill Creek and Des Plaines River are shown in figures 1 and 2 respectively.

On Sawmill Creek samples are collected weekly upstream and three times a week downstream from the waste water outfall. The upstream flow is roughly equal to the waste water flow yielding a dilution factor of one half. The data in table 3 show significantly higher concentrations downstream than upstream, a clear indication of the radioactivity contributed to the stream by ANL. A comparison of the downstream concentrations with the environmental MPC's listed in table 1 shows that all concentrations are quite low. The highest percent of MPC is that for Sr^{90} for the first quarter, 1.6%.

The data in table 4 do not show any significant difference in activity in Des Plaines River samples taken upstream and downstream from its junction with Sawmill Creek.

Soil and Grass Analysis for Iodine-131

Samples of surface soil and grass were collected on March 29 and 30, primarily to assess the deposition of iodine-131 to these materials from the I^{131} concentrations in air occurring during February and March. In order to relate the soil and grass data with that of air, the concentrations as measured on the date of collection were extrapolated back to March 17, the date that the highest I^{131} concentration was found in air samples. The measured and extrapolated values are tabulated in table 5. The sample location codes refer to the grid markings in figure 1. Off-site locations were

TABLE 3.—ACTIVITIES IN SAWMILL CREEK UPSTREAM AND D OWNSTREAM FROM WASTE WATER OUTFALL ANL

[Average concentrations in $\mu\mu c$/liter]

Type of activity	Sampling location	First quarter 1961		Second quarter 1961	
		Number of samples	Concentration	Number of samples	Concentration
Total alpha	Upstream	13	2.3	13	2.0
	Downstream	39	7.7	38	8.7
Total beta	Upstream	13	6.9	13	6.6
	Downstream	39	20.5	38	24.0
U-natural	Upstream	7	1.3	6	1.3
	Downstream	39	6.4	38	6.9
Pu^{239}	Upstream	3	<0.05	3	<0.05
	Downstream	39	0.08	38	0.06
Th^{234}–Pa^{234}	Upstream	7	1.0	3	1.0
	Downstream	39	5.1	38	6.0
Sr^{90}	Upstream	3	<0.5	3	<0.5
	Downstream	39	1.6	38	1.4
Cs^{137}	Upstream	3	<0.5	3	<0.5
	Downstream	39	1.7	38	2.7
I^{131}	Upstream	4	<2.0	3	<2.0
	Downstream	39	10.8	38	<2.0
Co^{60}	Upstream	2	<1.0	0	----------
	Downstream	12	1.0	0	----------
Co^{58}	Upstream	3	<10	1	<10
	Downstream	30	<10	23	81

TABLE 4.—ACTIVITIES IN THE DES PLAINES RIVER UPSTREAM AND DOWNSTREAM FROM SAWMILL CREEK, ANL

[Average concentrations in μμc/liter]

Type of activity	Sampling location	First quarter 1961		Second quarter 1961	
		Number of samples	Average concentration	Number of samples	Average concentration
Total alpha	Upstream	8	2.2	12	2.4
	Downstream	8	2.2	13	2.2
Total beta	Upstream	8	9.4	12	8.9
	Downstream	8	9.5	13	9.0
U-natural	Upstream	4	1.4	6	1.7
	Downstream	8	1.5	13	1.7
I^{131}	Upstream	0	----	1	<1.0
	Downstream	2	<1.0	2	<1.0

TABLE 5.—IODINE-131 ACTIVITY IN SOIL AND GRASS, ANL, 1961

[Concentrations in μμc/gram]

Location (*See fig. 1*)	Samples collected March 29 and 30				Concentrations in grass on dates of collection		
	Concentration at time of collection		Calculated concentration extrapolated back to March 17				
	Soil	Grass	Soil	Grass	May 11, 12	June 5	June 28
12 G	27 (4)	5,650	85 (4)	17,850 (4)	7.3 (4)	2.7 (4)	—
12 H	10 (4)	862	31 (4)	2,670 (4)	—	—	—
11 G	6.5	616	20	1,740	—	—	—
10 H	<0.3	376	<1	1,140	26.0	7.0 (4)	1.0 (4)
11 B	<0.3	5	<1	18	—	—	—
15 F	<0.3	<1	<1	<3.7	—	—	—
15 L	<0.3	<1	<1	<3.7	—	—	—
6 K	<0.3	4.9	<1	15	—	—	—
12 E	<0.3	23	<1	70	—	—	—
All off site points	—	<1 (5)	—	<3.7 (5)	—	—	—

— Indicates no samples taken.
Numbers in parentheses indicates number of samples.

Lemont, Joliet, Downers Grove, Lombard, and Tinley Park.

A cursory comparison of the data reveals that grass is a much more sensitive indicator of I^{131} than soil. No I^{131} was detected in soil more than 150 yards from the point of release, southeast corner of square 12G, figure 1. Small amounts of I^{131} were detected in grass samples taken at the western (11B) and southern (6K) edges of the ANL site.

Because of its higher sensitivity only grass samples were taken during May and June as a followup of the March 29-30 test. The May and June data, also shown in table 5 reflect the rapid decay of I^{131} and the much lower air concentrations during that time.

Atomics International

Canoga Park, California
Issued September 1961

Environmental levels of radioactivity at the Atomics International facilities have not been previously reported in *Radiological Health Data*. The following report presents a summary of the data for calendar year 1960, and the first two quarters of 1961.

The Nuclear Development Field Laboratory (NDFL) and the World Headquarters Facility (WHF) are operated for AEC by Atomics International (AI), Canoga Park, California. The locations of the two facilities are shown in figure 3.

The NDFL facilities include a 20 megawatt SRE power reactor; several smaller experi-

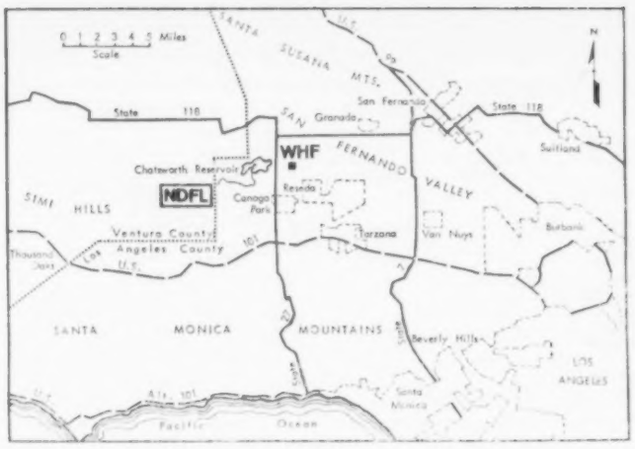


FIGURE 3.—ATOMICS INTERNATIONAL FACILITIES AND VICINITY

mental reactor facilities such as critical facilities, SNAP reactor, shield test facilities, and others; and extensive rolling and fuel fabrication operations. The major activities at the WHF are of the administrative type. However, a small amount of fuel fabrication is conducted at the site. For that reason the WHF area is included in the Atomics International environmental monitoring program.

Air Monitoring

Environmental air sampling is conducted continuously at the WHF and NDFL sites by automatic twenty-four hour step cycle air monitors. Airborne particulates are collected on a fixed filter tape which is moved, after each twenty-four hour period, to place the new sample beneath a thin window G. M. detector. At pre-set intervals, usually twenty minutes, the number of counts observed by the scaler during the interval is recorded.

It has been determined that for this type of instrument twice the counting rate after 18.6 hours decay minus the counting rate after 8 hours decay closely approximates the long-lived contribution. This counting rate can be converted easily to the average long-lived airborne activity ($\mu\mu c/m^3$) during the sampling period. The minimum detection limit, which varies somewhat between instruments, is on the order of 0.04 $\mu\mu c/m^3$. The average concentrations of long-lived airborne beta emitters are shown in table 6.

When abnormally high activities are observed, the data are plotted to determine the presence of short-lived activities other than radon and thoron daughters. If fallout is suspected, samples are removed to the laboratory where their decay is observed for a period of several days to several weeks. If the activity decays as a function of $t^{-1.2}$, the data is extrapolated in order to find the date of origin. This date is then compared with the dates of announced nuclear detonations in order to demonstrate that the abnormal airborne activity was not caused by Atomics International operations.

Water Monitoring

Two water wells at the Nuclear Development Field Laboratory are sampled monthly. Monthly surface samples are collected at the

TABLE 6.—AVERAGE CONCENTRATIONS OF RADIOACTIVITY IN AIR, WATER, SOIL, AND VEGETATION IN THE ATOMICS INTERNATIONAL ENVIRONMENT

Type of sample	Location	Activity	1960		First quarter 1961		Second quarter 1961	
			No. of samples	Average	No. of samples	Average	No. of samples	Average
Air ($\mu\mu c/m^3$)	WHF	β-γ	182	0.24	95	0.25	47	0.25
	NDFL	β-γ	44	0.44	42	0.40	[a]	
Water ($\mu\mu c$/liter)	NDFL wells	α	12	0.14	1	0.05	6	0.085
		β-γ	19	2.0	6	3.6	6	2.5
	Chatsworth Reservoir	α	0		0		15	0.39
		β-γ	0		0		15	7.7
Soil ($\mu\mu c$/gram)	On-site	α	104	0.45	17	0.32	30	0.47
		β-γ	114	23.0	30	37.0	30	35.0
	Off-site	α	324	0.36	45	0.30	112	0.35
		β-γ	360	19.0	96	24.0	112	24.0
Vegetation ($\mu\mu c$/gram ash)	On-site	α	89	0.41	13	0.24	30	0.32
		β-γ	113	136.0	30	167.0	30	152.0
	Off-site	α	281	0.28	48	0.19	113	0.35
		β-γ	358	135.0	96	156.0	113	135.0

[a] Data not available.

Chatsworth Reservoir, owned by the Los Angeles City Department of Water and Power. The average water activity is shown in table 6.

Soil and Vegetation Sampling

Soil and vegetation are sampled monthly at forty-eight locations. Ten of these are within the boundaries of the Atomics International sites; the remaining thirty-eight are within a ten mile radius of the sites. Data for soil and vegetation are shown in table 6.

Surface soil types available for sampling range from decomposed granite to clay and sandy loam. Collected samples represent the top one-half inch layer of ground surface.

Vegetation samples obtained in the field at each station are of the same plant type wherever possible, and are generally sunflower or wild tobacco plant leaves. These plant types maintain an active rate of growth during the dry season, a characteristic uncommon to most other plant types indigenous to the area.

Feed Materials Production Center

National Lead Company of Ohio, Fernald, Ohio
Issued September 1961

Environmental levels of radioactivity at the Feed Materials Production Center (FMPC) for 1959 and 1960 were reported in *Radiological Health Data,* Volume II, Numbers 4 and 6. The following report presents a summary of the data for the first and second quarters of 1961.

The FMPC, located in the Great Miami River Basin in southwestern Ohio, is operated by National Lead Company of Ohio (NLO) for AEC. The location, as related to populated areas, is shown in figure 4.

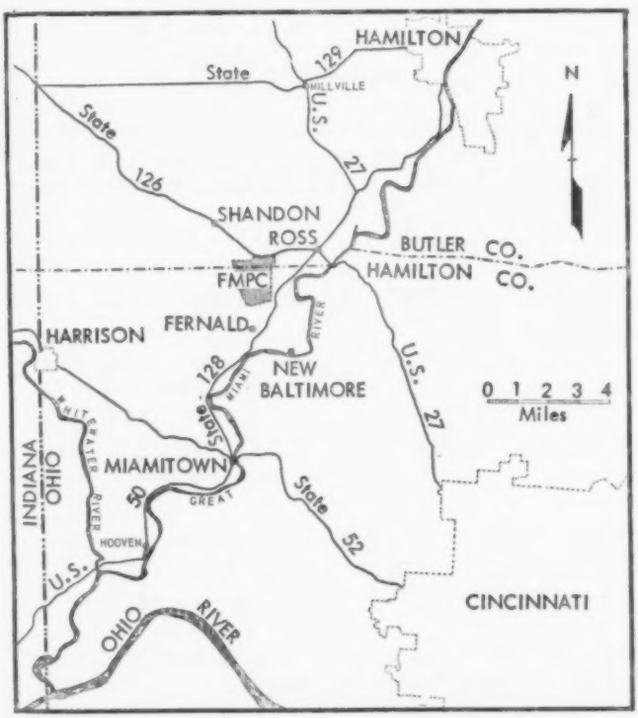


FIGURE 4.—AREA MAP OF FEED MATERIALS PRODUCTION CENTER

Operations at this project deal with the processing of high-grade uranium ores and ore concentrates to produce metallic uranium and the fabrication of the metal into fuel elements. Some details of the processes were reported in the issues referred to above.

To check the effectiveness of dust collectors and waste treatment processes, an environmental survey program of air and water sampling is maintained.

Air Monitoring

FMPC uses dust collectors such as bag collectors, electrostatic precipitations, and scrubbing towers which remove nearly all of the airborne particulates generated during the many involved processes. The environmental air sampling program provides an indication of the amount of material released into the atmosphere.

On-site samples were taken by four permanent sampling stations located at the four corners of the production area shown in figure 5. Off-site samples were taken by a mobile unit operated at various distances and directions from the plant. The data for the off-site samples are averaged in groups according to distance from the production area. Concentrations of uranium and total activity of airborne particulates sampled at on-site and off-site locations are given in table 7.

TABLE 7.—RADIOACTIVITY OF AIRBORNE PARTICULATES, FMPC

[Average concentrations in $\mu\mu c/m^3$]

Location	First quarter 1961			Second quarter 1961		
	Number of samples	Uranium	Total activity	Number of samples	Uranium	Total activity
On-site:						
Southwest	3	0.16	0.20	12	0.13	0.56
Northwest	10	0.07	0.14	12	0.09	0.22
Northeast	11	0.13	0.23	12	0.15	0.29
Southeast	11	0.12	0.27	12	0.21	0.33
All on-site samples	35	0.11	0.21	48	0.19	0.35
Off-site:						
0–2 miles from FMPC	6	0.29	0.52	6	0.15	0.28
2–4 miles from FMPC	22	0.21	0.33	18	0.05	0.30
4–8 miles from FMPC	10	0.26	0.43	16	0.13	0.30
8–10 miles from FMPC	2	0.48	0.09	6	0.11	0.37
All off-site samples	40	0.25	0.37	46	0.11	0.30

Water Monitoring

Continuous daily samples, collected from the combined sewer leading from the FMPC site to the Great Miami River are analyzed for uranium and total activity. The combined sewage is composed of treated liquid effluent from the production plants, water treatment plants waste effluent, storm sewer discharge, and treated sanitary sewage. Using the data from the combined sewage samples and stream flow data for the Great Miami River, the FMPC contribution to radioactivity concentrations in the river may be calculated. To check the calculated results, weekly upstream and downstream spot samples are taken. Table 8 presents a comparison of the calculated and the spot checked river concentrations. Sampling points are shown in figure 5.

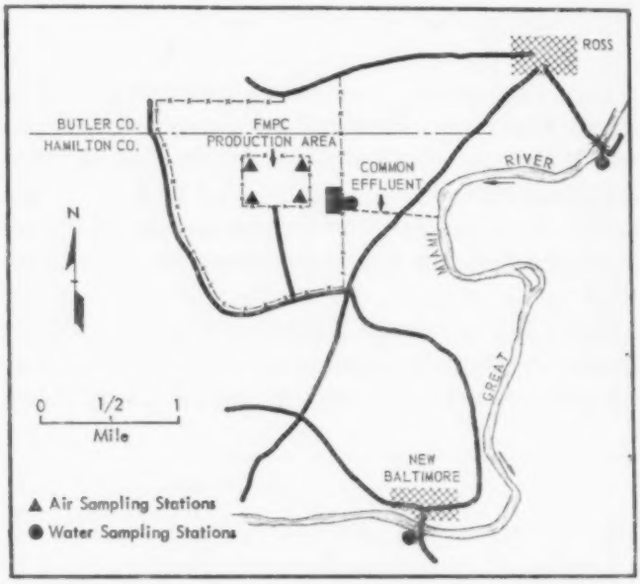


FIGURE 5.—AIR AND WATER SAMPLING STATIONS, FEED MATERIALS PRODUCTION CENTER

TABLE 8.—CONCENTRATIONS OF URANIUM AND TOTAL ACTIVITY IN THE GREAT MIAMI RIVER, OHIO

[Average concentrations in $\mu\mu c/m^3$]

Location	Method of determination	First quarter 1961			Second quarter 1961		
		Number of samples	Uranium	Total activity	Number of samples	Uranium	Total activity
Sewer outfall	Calculated from sewer concentrations and stream data (continuous sampling).	90	7	5	91	2	3
Upstream	Spot samples	15	10	34	15	12	35
Downstream	Spot samples	15	12	51	15	10	38

Note: Please make the following correction in the November 1961 issue (*Radiological Health Data*, Volume II, No. 11): In footnote 1 of table 3 on page 502 change "20 $\mu\mu c$/liter" to read "20,000 $\mu\mu c$/liter."

Environmental Monitoring in Alaska

Project Chariot
Atomic Energy Commission

In May 1959, the United States Atomic Energy Commission approved a program of environmental studies to be conducted in conjunction with a proposed excavation project using nuclear explosives (Project Chariot, Plowshare Program) at the mouth of Ogotoruk Creek in northwestern Alaska.

The proposed project, which is under study and for which the detonations have not been approved, would involve the simultaneous detonation of five nuclear devices. Four 20 kiloton devices would be buried to about 400 feet, and one 200 kiloton device buried to about 800 feet. The detonation would be expected to produce a channel about 900 feet wide and about 2,000 feet long, with an additional basin of about 1,800 feet in diameter resulting from explosion of the larger device. It is expected that about 95 percent of the fission products will be entrapped underground.

After the USSR resumed testing on September 1, 1961, four fallout monitoring stations were activated at Cape Thompson, Kivalina, Kotzebue and Point Hope, as shown in figure 1. The following tables present the first results from this monitoring.

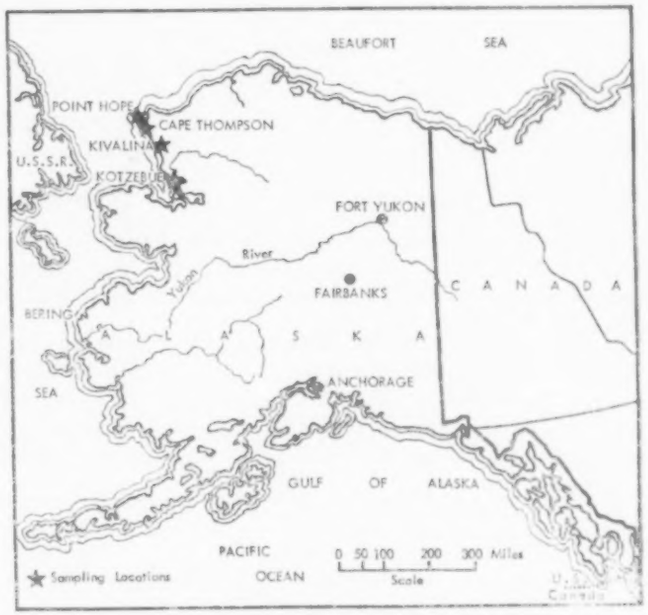


FIGURE 1.—SAMPLING LOCATIONS FOR PROJECT CHARIOT

TABLE 1.—GROSS BETA ACTIVITY IN ALASKAN AIR SAMPLES, SEPTEMBER, 1961

End of sampling period	Cape Thompson		Kivalina		Kotzebue		Point Hope	
	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)	Sampling time (hours)	Gross beta ($\mu\mu c/m^3$)
September 22	16.17	<0.10	2.08	<0.10				
23	23.25	3.64	2.33	<0.10			7.00	<0.10
24	29.50	0.15	3.58	0.62	19.92	0.39	13.00	1.78
25	24.33	1.76	4.42	0.71	21.00	0.71	7.00	0.15
26	25.78	1.18	3.42	0.78	24.17	0.67	6.50	5.28
27	23.22	11.2	2.08	44.7	24.08	3.40	14.75	22.2
28			3.75	7.27	24.17	4.82	15.17	7.80
29			5.00	5.75	23.25	49.3	12.92	4.50
30			3.42	17.0	24.17	16.2	11.58	3.20
October 1					26.58	16.4		

TABLE 2.—GAMMA SCAN OF ALASKA WATER SAMPLES, SEPTEMBER, 1961

Location	Date of sampling	Type of sample	Ba^{140}-La^{140} ($\mu\mu c$/liter)
Ogotoruk Creek	September 18	Surface water	[a] 470
Kivalina	September 22	Cistern water	240
Kotzebue	September 27	Tap water	<30
Point Hope	September 29	Surface water	<30
Camp Chariot	September 18–21	Rain water	1,300

[a] Trace amounts of Zr^{95}-Nb^{95} also observed.

Announced Nuclear Detonations

Radiological Health Data, Volume II, Numbers 10 and 11 published the dates of the Union of Soviet Socialist Republics announced nuclear detonations through November 2, 1961. The following table gives information on the last reported test in this series as well as data on reported United States underground tests through December 3, 1961. Low yield range has been announced as meaning about a nominal (20 kiloton) yield; low-intermediate to mean between a nominal and one megaton yield.

Test number	Location	Date	Size	Type of test
		ANNOUNCED U.S.S.R. SHOTS		
31	Novaya-Semlya	November 4	Several megatons	Atomospheric
		ANNOUNCED U.S. SHOTS		
1	Nevada Test Site	September 15	Low yield	Underground
2	Nevada Test Site	September 16	Low yield	Underground
3	Nevada Test Site	October 10	Low yield	Underground
4	Nevada Test Site	October 24	Low yield	Underground
5	Nevada Test Site	December 3	Low yield	Underground

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